PAMPHLET No. 41

COMMONWEALTH OF AUSTRALIA

Council for Scientific and Industrial Research

The Grading of Western Australian Timbers

Report on, and Suggested Specifications for, the Grading of Jarrah and Karri based on Investigations in 1932

By

F. GREGSON, B.E.,
Utilization Officer, Forests Department of Western Australia

And

R. F. TURNBULL, B.E.,
Utilization Officer, Division of Forest Products, Council for Scientific and Industrial Research

Report on Investigations carried out in Co-operation with the Forests Department of Western Australia

VERIFIED

LIBRARY
TNAU, Coimbatore - 3
000029535

AGRICULTURAL COLLEGE AND RESEARCH
No. 29535
6 OCT 19
COIMBAT

NE, 1933

…, Melbourne, for transmission by post as a periodical

H. J. Green, Government Printer, Melbourne

CONTENTS.

	PAGE
FOREWORD	4
SUMMARY	6
I. GENERAL CONSIDERATIONS—	
1. Introduction	7
2. Objects of the Investigation	8
3. The Importance of Various Products	8
II. RESULTS OF FIELD INVESTIGATIONS AND DISCUSSION OF QUALITY OF PRODUCTS—	
1. Ordinary Building and Construction Timber	11
(a) Jarrah Scantling (up to 25 sq. inches)	12
(b) Jarrah Heavy Scantling	21
(c) Karri Scantling (up to 25 sq. inches)	28
(d) Karri Heavy Scantling	31
2. Flooring—	
(a) Flooring—Strip	31
(b) Wood Block Flooring	44
3. Mine Lift Guides—	
(a) Jarrah Guides	54
(b) Karri Guides	56
4. Crossarms	58
5. Miscellaneous Products—	
(a) Wood Pipe	69
(b) Paving Blocks	71
(c) Wagon Scantling	73
(d) Joinery	73
(e) Wheelwright Scantling	74
(f) Timber for Re-sawing	74
III. DISCUSSIONS ON SAWING SIZES—	
1. Variations in Sawing	75
2. Relation of Nominal to Cutting Size	77
IV. COMPLETE LIST OF RECOMMENDED GRADING RULES—	
1. Ordinary Building and Construction Timber	81
2. Flooring	87
3. Mine Lift Guides	92
4. Karri Crossarms	93
5. Jarrah Paving Blocks	94
APPENDICES	95

FOREWORD.

The question of the grading of Australian timbers has recently become of increasing importance throughout the Commonwealth. For instance, it has become more and more apparent that lack of proper grading rules for permitting the supply of timber of uniform quality has been a serious disadvantage to the industry, not only in connection with the local trade but in connection with the greater development of the export trade.

Under the aegis of the Standards Association of Australia, committees have been set up in every State to deal with the problem. Unfortunately, such committees are severely handicapped in their deliberations by the lack of precise data, and the Division of Forest Products, which has been closely associated with the Standards Association in timber grading work, accordingly welcomed an invitation from the Forests Department of Western Australia for a co-operative grading investigation in that State. The Department, in conjunction with a Sawmillers Committee, had shortly before commenced field studies on flooring, and these preliminary tests had demonstrated that such a method of attack on the grading problem was likely to give very valuable results.

It is felt that this large grading investigation, extending as it did over five months, is of interest, not only to Western Australian sawmillers but to all those interested in timber throughout the Commonwealth. An indication of the amount of work involved in this study is given by the fact that over 35,000 pieces of timber were examined and their defects recorded and analyzed.

This is the first extensive study in Australian grading. In practically every previous case, attempts to define grades have been based on round-table conferences between timber producers, sellers, and users. While such conferences are of value in giving some idea of trade practice, the rules so developed frequently fail in practical operation, and very often, if applied, would seriously restrict production. The need for extensive field studies to provide the fundamental data for round-table discussions has been made obvious as the work of the Standards Committees progressed.

It is hoped that the publication of the report that follows will show the value of the method adopted, and lead to its use in all the States of the Commonwealth. There is no easy road to the development of standard grading rules, and if they are to prove useful they must be based upon similar studies to those described in the body of this report.

The thanks of the Division are due to Mr. S. L. Kessell, Conservator of Forests in Western Australia, who personally directed the investigation, and to Millar's Timber and Trading Co. Ltd., Bunning Bros., the Wilgarup Karri and Jarrah Co., and the State Sawmills, who rendered every facility for the field studies. Grateful acknowledgement is made both to the principals of these organizations and to local mill managers for their courteous treatment of the workers and their generous assistance at the mills and yards visited.

I. H. BOAS.

SUMMARY.

The report covers a co-operative field study extending over the latter half of 1932 on the grading of jarrah (*Eucalyptus marginata*) and karri (*Eucalyptus diversicolor*) aiming at the preparation of suitable grading rules to cover the supply of major products in these timbers.

Preliminary work leading to the investigation, its objects, and relative importance of the various classes of product are briefly outlined in Part I.

In various sections in Part II., results of detailed field work on each class of product are given. Tentative grading rules have been developed for major products. These have been tested out in the field whenever possible, and modified where necessary.

Recommended grading rules and specifications for all sizes of jarrah ordinary building and construction timber, jarrah flooring both strip and wood block, jarrah and karri mine lift guides, karri cross arms, and jarrah paving blocks are listed together in Part IV. Other specifications, particularly for karri building timber, which have not been developed or tested out to a similar extent, are not shown in the recommended list, but can be extracted from Part II. for use as trial specifications.

Field studies on the relation of cutting sizes to nominal sizes and variation in sawing are dealt with in Part III. Tentative recommendations are made showing what are considered to be reasonable allowable variations in sawing.

While some necessary modification of grading rules as first published is anticipated, it is claimed that these represent a very considerable advance on existing specifications.

The Grading of Western Australian Timbers.

Report on, and Suggested Specifications for, the Grading of Jarrah and Karri, based on Investigations in 1932.*

I. GENERAL CONSIDERATIONS.

1. Introduction.

At a general meeting of Western Australian saw-millers convened by the Conservator of Forests in August, 1931, to consider possible means for improving the position of the trade generally, it was resolved, *inter alia,* that the preparation of suitable grading rules to cover Western Australian timbers was essential for the progress of the industry, and that a committee of saw-millers should be appointed and continue to function until a reasonable set of grading rules had been drawn up.

Work by the committee was unavoidably slow, and subsequent to the presentation of draft specifications for milled flooring to the Sawmillers Association, in April, 1932, the committee has been more or less inactive. A study of the position with regard to grading by the secretary of the committee, F. Gregson, Utilization Officer of the Forests Department, W.A., resulted in the presentation in February, 1932, of a progress report entitled, "The Grading of W.A. Timbers for Export—A Study of the Present Position." This report indicated that existing specifications were by no means satisfactory or being adhered to, and stressed the need for further field investigation aiming at collection of data sufficient both to define the custom of the trade with respect to various classes of product and to serve as a basis for the preparation of more suitable specifications.

Subsequently, the Forests Department sought the assistance of the Division of Forest Products of the Council for Scientific and Industrial Research, which, co-operating with the Standards Association of Australia, had sponsored the consideration of timber grading in all States of the Commonwealth. Arrangements were then made for the Utilization Officer of the Division, R. F. Turnbull, to co-operate with F. Gregson in field studies for a period of five months commencing August, 1932.

During the period, detailed investigations have been carried out at representative saw-mills, and information has been supplemented by investigations at metropolitan yards and during the loading of a timber cargo at the port of Bunbury. Interim conclusions were drawn up in eight progress reports, one for each field study, and all available data have now been reconsidered for presentation in this report.

* Typescript received for publication, 5th May, 1933.

2. Objects of the Investigation.

Broadly speaking, the investigations aimed at the preparation of satisfactory grading rules for W.A. timbers. The basis of grading is the sorting of timber into qualities suited to various purposes. Sound grading practice lies not in the selection of perfect timber, but on the contrary, it aims at the inclusion in each grade of as many defects as is possible without detracting from the value of the timber for the purpose for which it is required. The principal aim in grading should be to promote uniformity in a product no matter from what source or from what tree it is obtained, so that a buyer can confidently expect a standardized quality when ordering a certain grade. Frequently, a large order is distributed to several mills, and the products of each mill are assembled at the shipping point into one consignment. Unless all the products have been uniformly graded to one standard, dissatisfaction is likely to result. A parcel below the average quality would give rise to complaint. On the other hand, a parcel of outstanding quality makes material which may be quite suitable for the purpose appear to be of indifferent quality. Again, such a parcel indicates that the mill may have sacrificed its timber unnecessarily to fulfil the order, and the value of the high-grade timber is often lost in association with the lower quality of the rest of the consignment. If rules were drawn up with a knowledge of buyers' requirements and producers' ability to supply, the amount of unsatisfactory material consigned would be reduced to a minimum, the buyer would know just what to expect and could order with confidence, and the seller would have a standard for his guidance.

At the outset, it was realized that in the allotted period of five months the problem could not be dealt with finally and exhaustively. The main concern, therefore, was to use the time available to the best advantage, and it can be confidently claimed that definite progress has been made. Unfortunately, the period during which the investigation was carried out was an abnormal one for the timber industry, and this fact must be kept in mind in considering all data and discussions thereon. Draft grading rules covering the major classes of product have been prepared, and are submitted for the consideration of the trade. Some modifications may be expected when criticism is received, but in their present or in a modified form they will be available for use when required. It is claimed that the grading rules suggested provide a much more satisfactory basis for supply than any existing specifications, and it is hoped that they will prove their value to the industry and that their general adoption will follow.

With reference to specifications for the guidance of timber inspectors, it is considered that in their final form the suggested grading rules can be readily interpreted, and are suitable for immediate adoption on a trial basis.

3. The Importance of Various Products.

Of all States in the Commonwealth, Western Australia exports the greatest quantity of timber, this representing over 80 per cent. of the Australian overseas export of undressed timber. The commercial forests from which this production is derived form a compact belt

of country parallel to, and within easy reach of, the seaboard. Fortunately for the organization of the industry, the species obtainable in commercial quantities are few.

Diagram No. 1 has been prepared to illustrate the importance of the various species in the State's production.

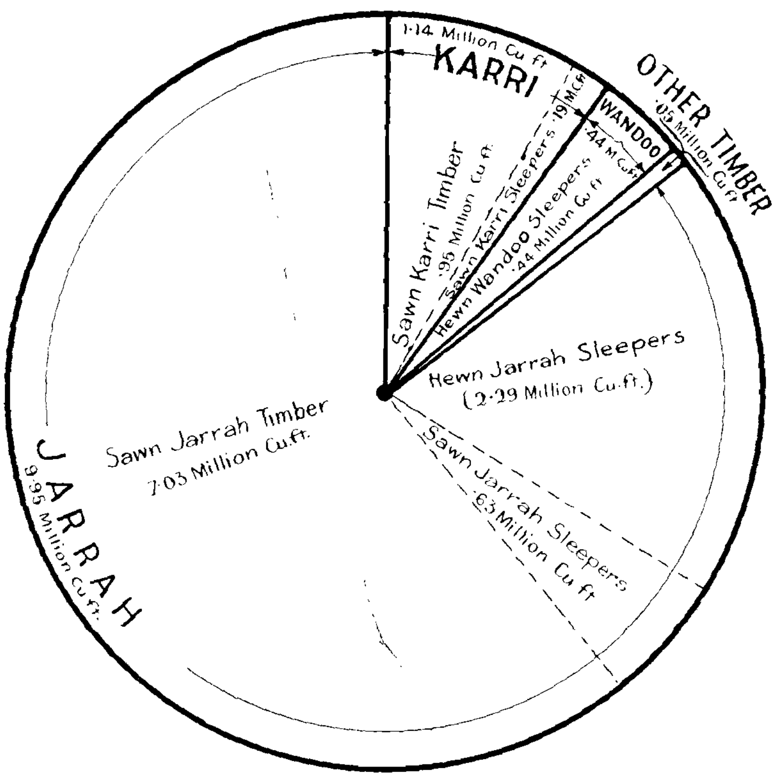

Diagram No. 1. Production of Western Australian Timbers. (Annual average in the square for 5 years.)

It will be noted that jarrah (*Eucalyptus marginata*) and karri (*Eucalyptus diversicolor*) are of primary importance. Investigations have been confined to these two species.

The diagram also shows the relative importance of sawn production in forest utilization, and gives a perspective of the relation of sleeper production to the total. The grading of sleepers has not been considered in this report mainly on account of the limited time available. Diagram No. 1 shows that sawn sleeper production is not a very great percentage of total sawn production. It is intended later to consider sleepers in an investigation on the whole problem of their production.

Diagram No. 2 divides the production into local and export trades. This division and figures for sleepers are based on a five-year period, but the subdivision of the export trade other than sleepers into the various classes of product is based on figures for the year 1931 only. These were supplied by various companies when the first progress report was being prepared. Figures over a longer period are desirable but are difficult to obtain. Similarly, the subdivision of the local trade other than sleepers is an estimate based on approximate figures supplied

DIAGRAM NO. 2. Distribution of Export and Local Trade in Western Australian Timbers

by several companies. The figures for one year indicate with sufficient accuracy for the purpose of these preliminary grading investigations the relative importance of the various classes of product with regard to export.

It will be realized that the timber production of Western Australia can be divided into a number of general and specific classes. The quality of these will be considered in detail in the next section of the report.

II.—RESULTS OF FIELD INVESTIGATIONS AND DISCUSSION OF QUALITY OF PRODUCTS.

The investigations described in this publication consisted of a series of field studies, in which, as far as possible, representative parcels of timber were subjected to detailed examination. In some cases, quantities of timber were graded and regraded according to varying trial specifications; in other cases, all defects present were noted both as to extent and frequency of occurrence, to serve as a basis for the drafting of grades.

The results of observations and discussions thereon are shown in this part of the report. Data with regard to individual products are discussed under separate headings. The question of sizes has been dealt with in more detail in Part III.

1. Ordinary Building and Structural Timber.

Included under this heading are all timbers used for ordinary building and general construction purposes, such as general building *scantling, planks and sheeting, bridge and harbour timbers, &c.* This group of products represents about 40 per cent. of the total production, being about one-third of the total export trade and about two-thirds of the local trade, apart from sleepers. Practically all timber included is used in the green or semi-green condition.

Present position.—Material is at present supplied in three grades—Select, Merchantable, and Seconds, the last-named grade applying to the local market only and mainly to scantling sizes. The Select and Merchantable grades are supplied nominally under hardwood grading rules (see Appendix No. 1*a*) which were adopted by the Sawmillers Association of Western Australia in 1921.

The Select grade admits a few small defects and is considered a fairly narrow grade. The specification for Merchantable is very general and does not define the grade. In practice, a wide variation is found in the quality supplied under the Merchantable grade to different destinations and from different mills. With such a general specification, it is obvious that complaints from the buyer must have a considerable effect on the quality supplied. Visiting officers in companies operating several mills endeavour to maintain uniformity in the standard of product supplied by the same firm. The existing specification does not, however, give much assistance as a guide to what the standard should be. A range of sizes from 3 x 1 to 18 x 18* cannot be covered effectively by a single specification.

Other varying specifications appear in tender forms, &c., of buyers, but none of these improves on the above rules. Specifications supposed to cover the supply of the following are attached:—

- Sawn jarrah logs and planks to South African Railways and Harbours—Appendix No. 1 (*b*).
- Australian hardwood to the Public Works Department, New Zealand—Appendix No. 1 (*c*).
- Sawn jarrah to the Commonwealth Railways—Appendix No. 1 (*d*).

* All sizes quoted throughout the text are in inch units.

Sawn jarrah to the Victorian Railways—Appendix No. 1 (*e*).

Sawn jarrah to the Melbourne and Metropolitan Tramways Board —Appendix No. 1 (*f*).

In 1928, a Western Australian sub-committee of the Standards Association of Australia drew up specifications intended to cover Australian hardwoods. These are set out in Appendix No. 2 (*a*). For ordinary building timber, the specifications are practically the same as those now used for select and merchantable timbers.

Procedure in 1932 *Field Investigations.*—Preliminary field work consisted in observing the grade limits under the present custom of the trade, and then in examining quantities of material in sufficient detail to permit the defining of suitable limits in a specification. The definition of the limits was tested in practice until workable specifications had been drafted. Further investigations were then made to determine the distribution of qualities in the mill production of scantling and to consider how the distribution would vary between mills. These data formed the bases for recommendations of grade limits for the trade.

(*a*) Jarrah Scantling (up to 25 square inches).

First consideration was given to jarrah building scantling in sizes up to 6 x 4.* The grade limits for merchantable scantling were observed generally during the loading of several trucks, and more detailed investigations of quality followed. Quantities of stock scantling graded by one mill as merchantable and seconds were re-classified according to tentative, but definite, limits. All doubtful pieces were described.

From this initial investigation, two points emerged clearly, namely, that (i) present grading is by no means consistent, and (ii) in a grade as wide as "merchantable," only a comparatively small percentage of pieces is defined by a specification covering the defects in limiting pieces.

The first point is demonstrated by comparing the defects included in mill grades. Frequently, the extent of a defect was less in pieces originally graded as seconds than in pieces graded as mill merchantable. When regraded according to consistent limits a parcel of mill merchantable grade showed 93 per cent. as merchantable quality and 7 per cent. seconds; while a parcel of mill seconds comprised 21 per cent. merchantable quality and 79 per cent. seconds. In practice, some variations in grading are inevitable, but in this instance they are far too great for good grading. The need for a more definite division between the two grades is evident. The limits could be adjusted, but raising the limit, while reducing the percentage of mill seconds showing as merchantable, would, at the same time, increase the percentage of mill merchantable showing as seconds.

The second point concerning the definition of a wide merchantable grade by a specification of limiting pieces, can be considered in its effect on (*a*) the ease of applying grading rules, and (*b*) the standard of products supplied under the rule.

In the original mill grading, it can be deduced (from figures not quoted in full in this report) that 68 per cent. were merchantable, 13

* Actually 5 x 5 was included under the title of scantling, so that this covered timber to 25 square inches cross-sectional area.

per cent. doubtful, and 19 per cent. second class. Hence it can be assumed conservatively, even with the vague border line between the two grades existing at the present time, that in the combined production 65 per cent. would have been definitely allocated to merchantable and 15 per cent. to seconds, thus leaving 20 per cent. doubtful. A detailed specification would then have to be used only in connexion with this 20 per cent. of the total scantling production. Its application is therefore reasonably simple.

The percentage of pieces shown as doubtful in the regrading was only 5, thus indicating that no very great variation between inspectors should be anticipated in applying a detailed grade limit.

While the fact that detailed grading rules need to be applied to a small percentage only of the pieces in a wide grade is an advantage from the point of view of applying grading rules, it is a disadvantage when considering the possible average standard of the grade. Normal production would probably give only about 15 per cent. approaching the grade limit but, with this only defined, there would be nothing to prevent the supply, within the grade, of a complete parcel containing pieces all just above the grade limit. This point would not be so important where a large number of grades are defined, but if it is intended to have only three, a considerable variation is possible in the grade, and a specification which would ensure the supply of a fair average parcel is difficult to draft. The whole aim of grading is to promote the supply of a uniform product. With a wide grade, a specification defining only the limiting piece cannot do this. This point is fully discussed later in the light of subsequent investigations.

Definition of grade limits.—Tentative grade limits based on observations at three mills were drafted to cover select and merchantable scantling. The grade limits adopted at this stage are equivalent to those listed as 1a and 1c in Part IV., except that no percentage restrictions were used. Their preparation represented the accomplishment of the first necessary step in the general grading study, namely, the definition of grade limits to serve as a measure of the present custom of the trade. No grade limit was placed on seconds, as it appeared customary to grade as seconds everything rejected from ordinary merchantable grade. It is thought, however, that the rejection of a comparatively small percentage of seconds by placing a lower limit on the grade would raise the value of the whole considerably.

Field tests of the grade limits and distribution of qualities in mill production.—Although only two grade limits had been defined in detail, mill scantling was measured in five quality groups by subdividing as follows:—

Select ..	High grade select. Select but approaching the limit.
Merchantable ..	High grade merchantable. Definitely merchantable. Merchantable but approaching lower limit.

These classifications indicate the quality distribution within the defined grades.

To test the defined grade limits, specifications were applied at Mill No. 3 to three days' cutting of a parcel of merchantable scantling destined for Melbourne. At the time observations were made, practically the whole (95 per cent.) of the mill output was ordinary building

scantling, the greater part of this being placed in the inter-state order. This order was considered to be typical of orders for building scantling being supplied at the time, so that the analysis represents fairly well the percentage of the various grades to be expected from the whole mill run. It should be noted, however, that no production of seconds was being aimed at. Ability to sell seconds would probably add 10 per cent. to the production from the same logs, and this would reduce the percentage (but not the quantity) of merchantable and select. Results of observations on 1,040 pieces are given in Table 1.

TABLE 1.—DISTRIBUTION INTO GRADES OF A PARCEL OF GENERAL JARRAH SCANTLING AT MILL No. 3.*

Grade.	Percentage of each grade in size groups of—				All pieces.
	3 x 1 to 6 x 1½.	4 x 3 to 7 x 3.	3 x 1 to 7 x 3.	8 x 3 to 8 x 8.	
Select	35	32	34	27	33
,, but approaching limit ..	16	17	16	13	16
					— 49
Merchantable†	38	38	38	33	38
,, but approaching limit	9	11	10	26	11
					— 49
Seconds	2	2	2	1	2
Number of pieces	603	327	930	110	1,040

* Sizes larger than 25 square inches cross-sectional area have been included in this table, but they are discussed later.

† Includes high grade merchantable at this mill.

Consideration of the table permits the following observations to be made:—

1. The custom of the trade is to supply, not merchantable scantling according to the definition of "merchantable" adopted by the Sawmillers Association, but a mixture of grades. In this particular case, the mixture comprised 49 per cent. select, 49 per cent. merchantable, and 2 per cent. of seconds.

2. The table definitely illustrates the possibilities in grading. At present, mixed orders of this kind are supplied at the one price in the same consignment, and the value of the best pieces may be lost by reason of their association with those of lower grade. The high percentage graded as select suggests that an inordinate sacrifice of high quality timber is being made to meet orders for general uses, and that an appreciable quantity of the mill run of scantling could have been put to special uses.

3. It can be clearly seen that a specification defining only the grade limit for merchantable, would be of little use for application to present trade practice in supplying nominal merchantable scantling to the eastern States. The specification would only reasonably cover those pieces shown as approaching the grade limit for merchantable, i.e., in this instance, 11 per cent.

4. Applying the grade limits both for select and merchantable to the parcel, a total of 27 per cent. is shown as approaching the grade limits.

The whole table is really necessary to define the custom of the trade as seen at this mill, but an approximation could be made by describing the parcel as containing a mixture of 50 per cent. select scantling, and 50 per cent. merchantable scantling with not more than one-third of the select and one-quarter of the merchantable approaching the grade limits as defined.

Variation in the quality distribution between mills.—After one parcel of scantling had been examined, it was necessary to determine how typical of the custom of the trade this parcel would be with regard to quality distribution. An accurate determination of the effect of the various factors involved is beyond the scope of the present investigation; hence the factors are merely stated and discussed generally. Briefly, the main factors influencing the quality produced are class of bush, class of other orders being cut, urgency of various orders, and customers' demands.

In the case of the Mill No. 3, practically no other orders were being cut, and the logs were obtained from good quality bush, so it is reasonable to assume that the conditions approached those under which the maximum amount of select material would be produced. Considering only select and merchantable as defined, the maximum percentage of select material to be expected in ordinary mill run of scantling will be approximately 50 per cent. The effect of poor bush on this percentage needs no stressing. When other orders absorb select material, it is obvious that the percentage of select grade in scantling must drop. When urgent delivery of an order is required, there is a tendency to cut all logs into that order irrespective of quality. This may result in the raising or lowering of its general quality according to whether the urgent order is for low- or high-grade material.

The variation in average quality of scantling, being influenced by so many factors, shows the need for properly defined grades.

Conditions favouring the production of a minimum percentage of select material in mill run scantling have not been encountered, but it is possible that these conditions would result in the production of scantling containing 20 per cent. select and 80 per cent. above the grade limits for select and merchantable respectively. There would be no comparison in average quality between a parcel of scantling produced under such conditions and a parcel produced under conditions seen at Mill No. 3, and yet each could be supplied in perfectly good faith as a parcel of merchantable scantling to the eastern States where, as at present, only a grade limit is nominally defined.

At Mill No. 4, a grading study of the whole mill output for a period of two and a half days was carried out. The sawn timber produced in this time, apart from battens and case shooks, amounted to 2,667 cubic feet, comprising 713 cubic feet of boards and linings, 1,207 cubic feet of scantling and construction timber, 567 cubic feet of heavy timbers, and 180 cubic feet of narrow gauge tram-line sleepers. Tentative grade limits were applied at the docker to the production of boards and linings. These results are discussed elsewhere. It can be said in passing that a considerable percentage of lower-grade boards were being produced, so that the cutting of some material into boards was not appreciably affecting the general quality going into scantling and ordinary construction timber.

Tentative grade limits for scantling and construction timber were also applied at the dockers. Results are summarized in Table 2. Heavy timbers are shown in a separate table discussed elsewhere.

TABLE 2.—DISTRIBUTION INTO GRADES OF GENERAL JARRAH SCANTLINGS.

Based on two and a half days' observation at Mill No. 4, and a production of 1,207 cubic feet.

Grade.	Percentage distribution of sizes 3 x 1 to 9 x 3 into each group.	
Select—		
High quality	32	
Approaching limit	12	
	—	44
Merchantable—		
High quality	13	
Definitely within grade	28	
Approaching limit	12	
	—	53
Reject	3	
Number of pieces	1,490	

The percentage of select material in this mill run scantling is high, although it is slightly below that found at the mill represented in Table 1. The general quality of the logs seen at Mill No. 4 was above the average expected in the locality. This was partly due to the fact that, at the time of observation, many special logs were being brought in to meet urgent orders for heavy timbers. It should be noted that, although the percentage of select material approached that found at Mill No. 3, the form would be different because logs were smaller, so that the average length and cubic measurement of individual sawn pieces must be smaller. This indicates that the quality would probably suffer where the production of a high percentage of long lengths and heavy timbers is attempted.

At Mill No. 5, a grading study on a shorter run of 286 pieces indicated a smaller percentage of select material in mill run scantling. The output of sizes up to 6 x 3 was 32 per cent. select (comprising 27 per cent. high quality and 5 per cent. approaching the select limit); 67 per cent. merchantable (15 per cent. high quality, 44 per cent. definitely within the grade, and 8 per cent. approaching the merchantable limit); and 1 per cent. rejects. A parcel of 3 x 2 and 4 x 2 stock scantling turned on the racks at this mill gave a distribution into 36 per cent. select (27 per cent. high quality and 9 per cent. approaching the limit); 55 per cent. merchantable (11 per cent. high quality, 36 per cent. definitely merchantable, and 8 per cent. approaching the limit); and 9 per cent. rejects. The greater percentage shown as rejects is mainly due to degrade during storage.

Tables 1 and 2 and the mill run data above show the percentage of select material in mill run scantling under varying conditions. Table 3 represents conclusions from observations at this stage as to the variations in quality which might be expected.

Table 3.—Variation in Quality under Varying Milling Conditions.

Milling Conditions.	Percentage of Grades.	
	Select.	Merchantable.
	%	%
Best	50	50
Average	35	65
Worst	20	80

The figures refer to that portion of the production above the merchantable limit. Assuming ability to sell lower-grade scantling of a quality encountered at Mill No. 2, the percentage figures (but not the quantity) of select and merchantable scantling would be altered. Table 4 represents approximately the quality distribution expected postulating ability to sell seconds.

Table 4.—Variation in Three Grades under Varying Milling Conditions.

Milling Conditions.	Percentage of Grades.		
	Select.	Merchantable.	Seconds or Common.
	%	%	%
Best	45	45	10
Average	30	55	15
Worst	16	64	20

Tables 3 and 4 show the distribution of qualities in mill run scantling. Limiting pieces forwarded in any order will vary according to the demands of particular customers, and the average quality will vary according to other factors already enumerated. At Mill No. 3, observations were made on a parcel for a single eastern State destination which was considered typical of the mill run. At Mill No. 4, however, the mill run was distributed to a South African order for select material only, a second South African order for merchantable quality subject to Forests Department inspection, and the balance to stock.

Approximately 1,500 cubic feet of mixed scantling and larger sizes for the second South African merchantable order were turned on the skids and graded according to the same limits as in the general mill study. The results are shown in Table 5.

Comparison of this table with Table 1 shows several interesting points. It will be noted that while the percentage of select pieces is smaller in Table 5, the percentage of pieces approaching the limit of merchantable is also smaller. This indicates more even grading at the latter mill. Since only a small percentage approaches the grade limit for merchantable, it follows that only a very small percentage

TABLE 5.—DISTRIBUTION ACCORDING TO GRADES OF MIXED JARRAH SCANTLING FOR SOUTH AFRICA AT MILL NO. 4.

Grade.	Percentage distribution of each grade in size groups.		
	4½ x 3 to 6 x 4.	9 x 3 to 12 x 6.	All sizes.
Select—			
High quality	31	33	32
Approaching limit	10	10	9
Merchantable—			
High quality	20	14	20
Definitely within grade	35	34	35
Approaching limit	3	7	3
Reject	1	2	1
Number of pieces	447	90	537

would be rejected by a specification with limits much more severe than those already defined. The tentative grade limit for merchantable scantling was defined after considering material mainly for the local market. Figures in Table 5, supported by general observations, indicate that a higher grade limit was being aimed at for the South African market. The presence of a small percentage approaching the merchantable limit as defined makes this limit the lower one for the quality being supplied.

The same grade limit passes 99 per cent. of the material for the South African market and 98 per cent. of the material for the eastern State market, and yet there is a very great difference in the average quality of the two parcels. This shows how inadequate is the definition of a single grade limit for defining the average quality now being supplied. The previous discussion has already brought out this point.

Recommendations.—Grade limits for the trade—The grade limits defined so far have been used to measure the custom of the trade, and have been based primarily on the requirements of the local trade. With regard to select, as it is a narrow grade, only one limit is necessary for the local and export market. The fact made evident in considering the merchantable scantling for export to South Africa, that a higher grade limit is being aimed at for export markets than for local markets, introduces a very considerable difficulty when only a few grades are practicable. There is insufficient material falling between the local and export grade limits for merchantable to justify establishing a grade between the two.

It should be recognized that, with regard to merchantable scantling, the local market can absorb a lower grade than the export market. To allow this, two alternatives are suggested—

1. Fixing the limit of merchantable to correspond with that accepted at the present time for the export market and endeavouring to establish another grade for the local market to be known as a "common" grade to correspond with the quality now called "good seconds."

2. *Defining two grade limits fairly close to each other*, one for export and the other for local trade, to be known as "merchantable A" and "merchantable B" specifications. A very general limit could then be placed on a lower common grade to cover supply of what are now seconds, but to eliminate pieces which are of no use for any purpose.

The latter alternative is favoured for the following reasons:—

(*a*) There would be less interference with present trade practices.
(*b*) There is no need for a detailed definition of a common grade.
(*c*) The way is still open, if desired in the future, to eliminate the merchantable B limit, raise the limit of common grade, and establish this grade at a higher value than the present value of "seconds."

It is suggested that there should be four grades to cover both the local and export trade, namely, select, merchantable A, merchantable B, and common. The limiting defects for these grades are given in detail in Part IV., under the rules numbered 1a, 1b, 1c, and 1d respectively.

Means of ensuring the supply of fair average quality.—Having defined the grade limits, the next step is to find some means of ensuring that a fair average quality is supplied. In other words, some clause or clauses must be added to prevent the supply of a whole parcel just above the grade limit. If a large number of grades are defined, as in American practice, this can be obtained by a general clause such as "The rule defines the poorest piece in the grade, but the grade shall contain all pieces up to the next highest grade," but where grades are wide this is not effective. A wide range is to be found from the select limit to merchantable A, and still wider from select limit to merchantable B.

There are two types of protective clauses which may be applied to prevent supply of a pareel all approaching the border line of the grade. The first type would only come into operation in particularly serious cases. Where, in an average mill run, 25 per cent. of the pieces above the grade limit might fall below a second slightly higher limit, the protective clause might state that not more than 40 per cent. should fall below this second higher limit. Such a clause would be a latent protection in that it would not affect ordinary production, quite an appreciable variation from average conditions being allowed before the clause would come into operation.

The second type of clause might be called a working protective clause. For the same conditions as above, it might specify that not more than 20 per cent. should fall below the second higher limit. The clause would then come into operation in practically every inspection, and should be of considerable assistance in maintaining a uniform grade. The latent protective clause has special advantages in narrow grades, and is recommended for wood block flooring, for instance, but for wide grades the working clause is preferred.

Earlier, it was suggested that "not more than 20 per cent. should approach the grade limit." The interpretation of the meaning of the phrase "approaching the grade limit" is difficult in this particular clause, and really postulates the definition of a second slightly higher

grade limit. The grade limit for merchantable A really constitutes this second slightly higher grade limit in relation to merchantable B. Scantling for the local market could then be defined by the grade limit for merchantable B with a working protective clause stating that not more than 20 per cent. should fall below the grade limit for merchantable A.

The next point to determine is whether the 20 per cent. is a reasonable allowance. Referring to Table 1, which shows the distribution in qualities for an eastern State order, it is noted that 23 per cent. of the pieces shown as merchantable approach the limit for that grade. The meaning of "approaching the limit" was not clearly defined at the time, but is now considered to correspond with the quality falling between the merchantable A and B limits. In Table 2, the figure is 22 per cent.; and at Mill No. 5, page 16, only 12½ per cent. Therefore, it appears from available figures that 20 per cent. offers a reasonable basis for a working clause. When, however, it is considered that this clause would result in a few additional rejects from the class of scantling seen at Mills No. 3 and 4, in addition to the small percentage already rejected by the grade limit, the question arises whether the percentage should be raised to 25 per cent. To remain a working clause, the percentage should approximate that in the average production of mill run scantling. The alternative figures of 20 per cent. or 25 per cent. are suggested, but the former is favoured.

In the case of the grade for export, it is considered impracticable either to define another higher limit just for the purpose of providing a protective clause or to use the phrase "approaching the grade limit." As an alternative, the following is suggested:—"Not more than 10 per cent. in volume shall be on the grade limit." with the ruling that a piece shall be considered "on the grade limit" when the inspector is undecided as to the correct placing of the piece in the grade.

The select grade is comparatively narrow, so that there is no great need for any clause to ensure fair average quality, but a similar clause to the above would probably be of considerable practical value to the inspector.

Mixed grades.—No provision has yet been made for specifications to cover the supply of mixed grades such as those shipped to the eastern States and to South Africa. Although described as merchantable scantling, these were really a mixture of grades. To permit trading in mixed grades, it would be necessary to specify "scantling merchantable A and better," or "scantling merchantable B and better," with defined percentages of select and merchantable. The average quality in parcels bought on this basis would not be as constant as in parcels bought within separate grades. The percentage of select grade in mixed parcels could only be fixed on an average production, and should be lower than that shown in Table 2, which represents conditions under which the maximum amount of select material would be produced.

Percentages of various grades expected are given in Tables 3 and 4. The merchantable grade corresponds to the merchantable B specification, but this could be taken as consisting of 75 per cent. merchantable A, and 25 per cent. between merchantable A and B.

Under average conditions, a mixed grade of merchantable A and better should consist theoretically of 41 per cent. select, 4 per cent. select, but approaching the limit, plus 49 per cent. above the merchantable A limit, and 6 per cent. on this limit. A specification for a mixed grade can only aim at fair average quality. If more definite quality is required, individual grades should be ordered. The following is suggested as a workable specification for mixed scantling:—

Mixed Scantling, Merchantable A and Better.—The parcel shall consist of not less than 40 per cent. select scantling, not more than 10 per cent. on the limit of merchantable A and the balance definitely within the grade limit of merchantable A.

Mixed Scantling Merchantable B and Better.—The parcel shall consist of not less than 30 per cent. select scantling, not more than 15 per cent. between the grade limits of merchantable A and merchantable B, and the balance above the grade limit of merchantable A.

Complete recommendations are given in the general set of specifications in Part IV.

(*b*) Jarrah Heavy Scantling.

The preliminary work on large sizes was carried out at Mill No. 3 during the loading into trucks of approximately 2,000 cubic feet of bridge and harbour timbers for South Africa.

Owing to handling problems, a sufficient quantity of heavy pieces is difficult to describe on the mill skids, unless loading is in progress. With the aid of partly formulated specifications and a convenient rate of loading of heavy pieces, it was possible to record surface defects on nearly every piece loaded. In the parcel for South Africa, 85 pieces of 9 inches x 4 inches, mainly 32 ft. 6 in. long, and 87 pieces of larger size up to 16 inches x 9 inches were described.

The complete nominal specification covering the supply of this timber is given in Appendix No. 1 (*b*).

This South African specification is better drafted than the ordinary type of existing specifications, but could more reasonably be applied to cover supply of a higher grade of timber.

As a commencement to obtain some idea of how the class of material being supplied actually compares with the specification, the latter has been applied to observations as recorded, but allowing gum pockets up to 4 inches x ⅜ inch. Pieces showing defects which would be rejected on the specification were roughly classified according to the defect and extent. Results are shown in Table 6.

Observations thus show that less than 60 per cent. are within the nominal specification. Consideration of recorded defects showed that a slight lowering of the specification would not greatly increase the admitted number of pieces. To admit a reasonable percentage, the specification has to be dropped down to one corresponding to the merchantable specification 1c for scantling given in Part IV.

Treating as select those pieces shown in the table as within the specification and as high-grade merchantable those showing less gum than 20 per cent. of length on any one face, the balance were reclassified

on the scantling merchantable specification as it stands (scantling merchantable B) and the whole shown in Table 7.

TABLE 6.—RELATION OF QUALITY OF BRIDGE AND HARBOUR TIMBER TO QUALITY NOMINALLY SPECIFIED.

Timber for South Africa at Mill No. 3.

Size (Inches).	Within S.A. specification, but allowing gum pockets 4 x ⅜.	Gum pockets in excess of 4 x ⅜, with or without gum veins.	Gum exceeding 20 per cent. any one face.	Gum exceeding 20 per cent. all faces.	Other defects.	Total.
16 x 9	5	3	2	3	..	13
12 x 9 and 12 x 8	24	6	10	7	1 cross-grain 1 wane	49
12 x 6	9	..	1	1	..	11
12 x 3	6	..	..	1	..	7
9 x 6 and 9 x 8 ..	1	4	2	..	..	7
9 x 4—32′ 6″ ..	54	6	8	17	..	85
Total ..	99	19	23	29	2	172
Percentage ..	57	11	13	17	1	..

TABLE 7.—RELATION OF QUALITY OF BRIDGE AND HARBOUR TIMBER TO MERCHANTABLE B SPECIFICATION FOR SCANTLING.

Timber for South Africa at Mill No. 3.

Size (Inches).	Select.	Merchantable B.		Reject.	Total.
		High Grade.	Approaching Limit.		
16 x 9	5	5	3	..	13
12 x 9 and 12 x 8 ..	24	8	13	4	49
12 x 6	9	2	..	..	11
12 x 3	6	1	..	..	7
9 x 8 and 9 x 6	1	1	2	3	7
9 x 4	54	22	6	3	85
Total Distribution ..	99	39	24	10	172
Percentage	57	23	14	6	..

The grade limit as written covers 94 per cent. of the pieces as seen, rejecting 10 pieces out of 172 examined. It is interesting to note that a specification defining this grade limit alone would come into operation only on the 24 pieces shown as approaching the grade limit plus the ten pieces shown as rejects.

The whole of Table 7 is really necessary to show the custom of the trade as seen at Mill No. 3, with regard to shipment of heavy timbers to South Africa.

The custom of the trade might then be briefly described as the supply of a mixed grade consisting of 60 per cent. select grade and 40 per cent. merchantable.

The select grade limit written for scantling under 6 x 4 becomes a very severe limit when applied to very large sizes. That nearly 60 per cent. of a shipment will comply with this strict select specification, and that such a wide specification of merchantable B is necessary to cover the balance, is sufficient to show the desirability of two grades.

It would seem reasonable that to obtain the same nominal grade, larger individual defects should be allowed in the bigger sizes. A consideration of defects in pieces rejected in Table 7 indicates that for sizes over 100 square inches an increased allowance in gum pockets measured on the quarter to 7 inches x ½ inch would be desirable. Some increase in allowance for knots is also necessary, the following being suggested:—"Allow tight intergrown knots, other knots up to 1½-in. diam. if not deep."

It is not considered desirable to increase the allowance for gum veins. Wane on the other hand has to be limited—an allowance of one-sixth the dimension on which it occurs, but not to exceed 2 inches or one-sixth the length is suggested.

With these modifications, the grade limit would admit practically every piece seen at Mill No. 3. The grade limit is then covering supply of material to an export market and, as a lower grade is used with heart-in beams and possibly for the local market, this grade limit should be termed "heavy timbers—merchantable A."

Derivation of other grade limits.

With three grade limits defined for sizes up to 25 square inches section and one tentative grade limit defined for larger sizes, trial grade limits may now be written for all sizes by increasing or reducing allowable defects. The derivation of other grade limits has been shown in Table 8. The grade limits for sizes up to 25 square inches have already been defined, and these with a grade limit for merchantable A in sizes 100 square inches and over written on data just discussed, form a basis for derivation of select and merchantable B limits in sizes 100 square inches and over and of all limits in the intermediate size.

At this stage in the discussion, these other limits must be regarded as trial specifications. Field data on these other sizes and grades would be insufficient to write grades without further evidence. Below, we have discussed field observations on various parcels of intermediate and larger sizes with particular reference to the suitability of the trial specifications above.

Parcel of construction timber intermediate sizes.—One hundred and ten pieces of a merchantable order in sizes from 8 inches x 3 inches to 8 inches x 8 inches were described in detail. This order was for the Melbourne market. The distribution according to the grade limits for select and merchantable B scantling under 6 x 4 is given in Table 1. It will be noted that only 29 pieces are shown as approaching the merchantable limit, and these 29 pieces are therefore all that are available in this parcel for judging the suitability of the grade limit. A re-examination of the detailed data with regard to the 29 pieces showed that the specification merchantable B for sizes 26-99 square inches would readily admit each piece.

Table 8.—Jarrah—Ordinary Building and Construction Timber—Derivation of Grade Limits for all Sizes.

Grade Limits for Select.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	100 square inches Sectional Area and over.
Wane	**Trace only .. ..**	One-twelfth the dimension on which it occurs, but not to exceed ¾	One-twelfth the dimension on which it occurs
Gum pockets on any face	**4 x ⅜ measured on the quarter in any 5 lineal feet**	One 5 x ⅜ measured on the quarter in any 5 lineal feet	One 6 x ⅜ measured on the quarter in any 5 lineal feet
Gum veins, no pockets on any face	**Total length one-eighth length of the piece; individual lengths not to exceed 2 feet**	Total length one-sixth the length; individual lengths not to exceed 3 feet	Total length one-quarter the length; individual lengths 4 feet
Gum veins associated with limiting pockets on any face	**As above .. ..**	Total length one-eighth the length	Total length one-sixth the length
Knots	**One tight intergrown to 1″ diameter in any 5 lineal feet**	One tight intergrown to 1¼″ diameter, or one other up to ¾″ diameter if not through, in any 5 lineal feet	One tight intergrown up to 2″ diameter, or one other knot up to 1¼″ diameter if not deep, in any 5 lineal feet
Pinholes	**Scattered, up to ten per ½ square foot**	Scattered, up to ten per ½ square foot	Scattered, up to ten per ½ square foot
Cross grain ..	**Free from serious ..**	Free from serious ..	Free from serious
Other	**Equivalent defect ..**	Equivalent defect ..	Equivalent defect

Allowing any two of above.

Grade Limits for Merchantable A.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	**100 square inches Sectional Area and over.**
Wane	**Not to exceed one-sixth the dimension on which it occurs, or one-sixth the length**	Not to exceed one-sixth the dimension on which it occurs, or 1½″ or one-sixth the length	**Not to exceed one-sixth the dimension, or 2″ or one-sixth the length**
Gum pockets on any face	**One 5 x ⅜ measured on the quarter in any 5 lineal feet**	One 6 x ⅜ measured on the quarter in any 5 lineal feet	**One 7 x ½ measured on the quarter in any 5 lineal feet**
Gum veins, no pockets on any face	**Total length one-third the length: individual lengths not to exceed 4 feet**	Total length one-third the length; individual lengths not to exceed 4 feet	**Total length one-half the length; individual lengths not to exceed 6 feet**
Gum veins associated with limiting pockets on any face	**Total length one-sixth the length**	Total length one-sixth the length	**Total length one-fourth the length**
Knots	**One tight intergrown up to 1¼″ diameter, or one other knot up to ¾″ diameter if not through, in any 5 lineal feet**	One tight intergrown up to 1½″ diameter, or one other up to 1″ diameter if not through, in any 5 lineal feet	**Tight intergrown, or one other up to 1½″ diameter if not deep, in any 5 lineal feet**
Pinholes	**Not to exceed fifteen in any ½ square foot**	Not to exceed fifteen in any ½ square foot	**Not to exceed fifteen in any ½ square foot**

Allow any single defect and, in addition, a combination of smaller defects equivalent to one of the above, provided that the combination of defects on all faces at any section will not materially affect the strength of the piece.

TABLE 8—*continued.*

Grade Limits for Merchantable B.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	100 square inches Sectional Area and over.
Wane	**Not to exceed one-quarter the dimension on which it occurs, or one-quarter the length**	Not to exceed one-quarter the dimension on which it occurs, or 1½″ or one-quarter the length	Not to exceed one-sixth the dimension, or 2½″ or one-quarter the length
Gum pockets on any face	**One 6 x ⅜ measured on the quarter in any 5 lineal feet**	Not to exceed one 7 x ½ measured on the quarter in any 5 lineal feet	Not to exceed one 9 x ¾ measured on the quarter in any 5 lineal feet
Gum veins, no pockets on any face	**Total length not to exceed one-half the length**	Total length not to exceed one-half the length	Total length not to exceed three-quarters the length
Gum veins associated with limiting pockets on any face	**Total length not to exceed one-quarter the length**	Total length not to exceed one-quarter the length	Total length not to exceed one-third the length
Knots	**One tight intergrown up to 1½″ diameter, or one other up to 1 diameter if not through, in 5 lineal feet**	One tight intergrown up to 2″ diameter, or one other up to 1½″ diameter if not through, in 5 lineal feet	Tight intergrown, or one other up to 2″ diameter if not deep, in any 5 lineal feet
Pinholes	**Not to exceed twenty in any ½ square foot**	Not to exceed twenty in any ½ square foot	Not to exceed twenty in any ½ square foot

Allow any single defect and, in addition, a combination of smaller defects equivalent to one of the above, provided that the combination of defects on all faces at any section will not materially affect the strength of the piece.

The portions in heavy type have been drawn up from a study of large parcels of timber. Those in lighter type have been deduced from these, but have been checked by examination of smaller parcels of timber.

Parcel of planking for United Kingdom.—Application of the trial grade limits for intermediate sizes to detailed observations on 62 pieces of 12 x 4 and 9 x 4 planking 12 feet and up gave the following:—

Select	31
Merchantable A	22
Merchantable B	9

This material was probably required for decking. The grade limit for merchantable B is the one necessary to cover the whole parcel.

Parcel of 90 pieces of intermediate sizes for South Africa.—Forests Department inspection was specified in this order. The distribution according to grade limits for material under 6 x 4 has already been given in Table 5. Sizes range from 9 x 3 to 12 x 6, and of these all except eight pieces of 9 x 3 would be covered by the merchantable A limit applying to 6 x 4. Field data indicate that slight docking would raise three of the pieces to the higher grade, leaving only five pieces not covered by the grade limit. Increased allowances for defects would probably admit two or three of these, so that it is reasonable to say that practically the whole parcel would be covered by the merchantable A specification for intermediate sizes.

Parcel of heavy scantling for the local market.—At Mill No. 4, 31 pieces were examined ranging in size from 9 x 9 to 16 x 9 in lengths up

to 24 feet. An examination of detailed field data indicated that, allowing heart-in beams with defects as limited in merchantable A, to be equivalent to the merchantable B, practically every piece would be admitted within the merchantable B limit. It was noted however that the pieces classified as doubtful were so described on general quality of the timber and not on defects as defined in the specification. Apart from the question of the general quality of the timber, the actual location of the defect has a great deal to do with the suitability of the piece. It is thought that with regard to sections 100 square inches and over, the limitation of defects as given should be used as a guide only with due consideration to the general quality of the piece and the location of defects.

Three pieces showed end shakes visible in one case on the cross section only, and in the other two cases on one face as well. The usual practice with regard to end shakes in large sizes is to cut these back successively at the docker until no shake is visible. The ends (as with all heavy sizes) are then coated with petrolatum. The docking back till little or no trace of the shake is visible does not mean that the shake has been entirely eliminated, and it is thought that for the merchantable specification some allowance for shakes should be made. A slight indication that a shake is present in material which has been on the skids for a few days should not be sufficient cause for rejection in these grades of material. The following clause is suggested:—

"*Shakes.*—Merchantable A and B. Longitudinal shakes will be allowed at the discretion of the inspector, but, if running to an end, the length shall not exceed the greatest cross sectional dimension of the piece, nor shall the shake run from one face to another on the end section."

Parcel of jarrah decking.—Quality observations on 258 pieces of jarrah decking 9 inches x 4 inches x 32 ft. 6 in. long were made at time of loading at ship side. The material was from four different mills, but the quantity from each was not sufficient to justify comparisons.

It was found impossible to note defects in very great detail. In making notes, the merchantable B specification for scantling under 6 x 4 was used as a guide, and an endeavour was made to note all pieces showing defects approaching or exceeding that limit.

The grade limit for merchantable B for sections 26-99 square inches has been applied to the observations of 258 pieces of jarrah decking, and resulted in 85 per cent. being classed as definitely merchantable or better, 12 per cent. approaching the grade limit, and 3 per cent. rejects. Since the specification covers 97 per cent. of the pieces, it is considered reasonably satisfactory.

A very wide specification would have been necessary to cover the remaining 3 per cent. The supply of even a small percentage of such pieces in a shipment definitely lowers the value of the whole. Passing to the merchantable B specification, a very lax interpretation would have rejected practically every piece shown as rejected. On the other hand, a strict interpretation would have affected only a small portion of the 12

per cent. shown as approaching the grade limit. With the reasonably definite specification, therefore, little variation between inspectors would be anticipated.

Bridge and harbour timbers for Fremantle.—Observations on twenty pieces of bridge and harbour timbers in sizes from 8 inches x 6 inches to 14 inches x 6 inches at Mill No. 1, and 30 pieces at Mill No. 2 indicate that the merchantable B specification should satisfactorily cover this class of material for the local market. Two pieces rejected by the specification were definitely unsuitable.

Select material.—Consideration of quality in special products gives a very fair idea of the suitability of proposed grade limits for select construction timbers. It would be expected that the quality for mine guides would be approximately the same as selected construction timber with such special modifications as are necessary for this particular product. A comparison of grade limit for mine guides and that for select construction timber between 26 and 99 square inches indicates that the latter is in its correct position.

In addition to material above, small quantities of larger size material have been examined at several of the mills visited. Each small parcel cannot lead to definite conclusions as only a small percentage approaches the grade limit, but the general conclusion on all observations is that the proposed grade limits form a satisfactory basis for the formulation of workable specifications.

Means of ensuring fair average quality.—As with scantling sizes up to 6 x 4, it is found in larger sizes that the specifications only operate on a small percentage of the pieces. Similar protective clauses are suggested as with scantling sizes. In the case of the merchantable B specification, it is suggested that in any parcel not more than 25 per cent. in volume should fall below the merchantable A specification. With the select and merchantable A specifications, it is suggested that parcels should contain not more than 20 per cent. and 15 per cent. in volume respectively on the grade limit. With merchantable A and merchantable B scantling under 25 square inches, it is intended that the grade need only consist of pieces below the grade limit for select, unless merchantable A and better or B and better is specified. With the corresponding limits in larger size, however, it is thought unlikely that a mill would be cutting at the same time orders for select and merchantable material in the same sizes. In the case of orders to either merchantable A or B limits, therefore, a considerable percentage of select material would be supplied. Since the practice will be to supply mixed qualities in this way, in the case of these larger sizes, there is considered to be no advantage in writing a specification for merchantable A and better or B and better, specifying a certain percentage of select material. For such sizes, we can see no great advantage to the buyer in having such a percentage very much higher quality than the average; the main point is to prevent supply of too large a percentage of faulty pieces on the border line.

Recommended specifications drawn up on these grade limits and discussion thereon are given in Part IV.

(c) Karri Scantling (up to 25 square inches).

During the period of investigations at Mills Nos. 6 and 7, no karri building scantling was being cut. At Mill No. 6, large stocks of 3 x 2 and 4 x 2, produced as a by-product during the cutting of a special product, had accumulated, and as no sales were forthcoming further production had been stopped.

The limited local trade in karri building scantling in sizes up to 25 square inches has a very considerable effect on the quality of the small amount that is sold. Since all the merchantable scantling produced incidentally to the cutting of special products cannot be disposed of, there is definitely no market for seconds, and further, the natural tendency is to raise the quality above merchantable in an endeavour to foster the trade. Consequently, on the local market, karri described as merchantable would be at least equivalent in quality to jarrah described as merchantable for the overseas market.

In order to examine the quality of stock scantling, a parcel of 317 pieces of 3 x 2 and 4 x 2 was graded according to the limits considered equivalent to those adopted for jarrah.

The results of observations are shown in Table 9. The merchantable limit is that which was later defined as merchantable B; the lower limit of those shown as definitely merchantable corresponds approximately with the grade limit of merchantable A.

TABLE 9.—QUALITY OF KARRI STOCK SCANTLING AT MILL NO. 6.

Grade.	Distribution into Grades.	
	Number of Pieces.	Per cent.
Select—		
Clear	25	8
Very small defects	92	29
Approaching grade limit	60	19
		—56
Merchantable—		
High quality	57	18
Definitely within grade	48	15
Approaching limit	25	8
		—41
Reject	10	3

Figures in Table 9 show that 56 per cent. of the material would be classed as select, 41 per cent. as merchantable, and 8 per cent. of the total approaches the grade limit of merchantable B. While the supply of scantling exceeds the demand, it can definitely be considered faulty practice to put into stock material approaching the merchantable limit. Mounting stocks prohibit further cutting, and better quality material goes over the fire chute than is held in the stacks. Rejecting, therefore, all the material shown as approaching the merchantable limit or worse, the percentage of select material would rise to 63 per cent. This seems to be a justification for defining a grade limit allowing very small defects to be called specially-selected karri.

The grade limits written for karri scantling aim at the production of qualities equivalent to jarrah graded under corresponding specifications. It is important that the same grade limit should represent the same standards of quality in both jarrah and karri. The essentials of the suggested grade limits for karri scantling up to 25 square inches are included in Table 10. In addition, the following specification is suggested for a specially select grade:—

Karri Scantling, Specially Select (up to 25 square inches).—

To be practically free from defect and sap but allowing the following to the extent indicated:—

1. Tight gum veins not to exceed 9 inches x ⅛ inch in any 10 feet.
2. An occasional ¼-in. grub hole.
3. Equivalent defect.

The limits for select, merchantable A, and merchantable B are set out in Table 10.

These grades have not been included in the recommended lists of Part IV. Investigations in karri building scantling were not sufficiently comprehensive for definite conclusions, and these grade limits should be regarded for the time being as trial specifications.

TABLE 10.—KARRI—ORDINARY BUILDING AND CONSTRUCTION TIMBER—DERIVATION OF GRADE LIMITS FOR ALL SIZES.

Grade Limits for Specially Select.

No corresponding grade limit suggested for sizes above 25 square inches sectional area.

Grade Limits for Select.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	100 square inches Sectional Area and over.
Wane	**Trace if fluarised ..**	If fluarised one-twelfth the dimension on which it occurs, but not to exceed ⅜″; if untreated free from wane	If fluarised one-twelfth the dimension on which it occurs; if untreated trace only
Sap	**No defect if fluarised; trace if untreated**	No defect if fluarised; if untreated one-twelfth the dimension on which it occurs	No defect
Gum pockets on any face	**Not to exceed 4 x ⅜ measured on the quarter in any 5 lineal feet**	Not to exceed one 5 x ⅜ measured on the quarter in any 5 lineal feet	Not to exceed one 6 x ⅜ measured on the quarter in any 5 lineal feet
Gum veins, no pockets on any face	**Total one-tenth length of piece; individual lengths 18″**	Total length one-eighth the length; individual lengths not to exceed 2 feet	Total length one-sixth of the length
Gum veins associated with limiting pockets on any face	**As above .. ..**	Total one-tenth the length	Total one-eighth the the length
Knots	**One tight intergrown up to 1″ diameter in any 5 lineal feet**	One tight intergrown to 1¼″ diameter, or one other ⅞″ diameter if not through, in any 5 lineal feet	One tight intergrown up to 2″ diameter, or one other up to 1¼″ diameter, in any 5 lineal feet
Grub holes ..	**Not to exceed one ⅜″ hole in any 2 lineal feet**	Not to exceed one ⅜″ hole in any lineal foot	Not to exceed one ½″ hole in any lineal foot
Other	**Equivalent defect ..**	Equivalent defect ..	Equivalent defect

TABLE 10—*continued.*

Grade Limits for Merchantable A.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	100 square inches Sectional Area and over.
Wane	**Free from wane** ..	If fluarised not to exceed one-sixth the dimension on which it occurs, or 1½" or one-sixth length; if untreated free of wane	If fluarised not to exceed one-sixth the dimension, or 2" or one-sixth the length; if untreated not to exceed one-twelfth the dimension
Sap	**No defect**	No defect	No defect
Gum pockets on any face	**Not to exceed one 5" x ⅜" measured on the quarter in any 5 lineal feet**	Not to exceed one 6" x ⅜" measured on the quarter in any 5 lineal feet	Not to exceed one 7" x ½" measured on the quarter in any 5 lineal feet
Gum veins, no pockets on any face	**Total one-quarter the length; individual lengths 3 feet**	Total length one-quarter the length; individual lengths not to exceed 3 feet	Total length not to exceed one-third the length; individual lengths not to exceed 4 feet
Gum veins, associated with limiting pocket on any face	**Total one-eighth the length**	Total length one-eighth the length	Total length one-sixth the length
Knots	**One tight intergrown up to 1¼" diameter, or one other knot up to ¾" diameter if not through, in any 5 lineal feet**	One tight intergrown up up to 1½" diameter, or one other up to 1" if not through, in any 5 lineal feet	Tight intergrown knots, or one other up to 1½" diameter if not deep, in any 5 lineal feet
Grub holes ..	**Not to exceed one ½" hole in any 2 lineal feet, or one ⅜" hole in any lineal foot**	Not to exceed one ½" hole in any lineal foot	Not to exceed one ⅜" hole in any lineal foot

Allow any single defect and, in addition, a combination of other defects equivalent to one of the above, provided that the combination of defects on all faces at any section will not materially affect the strength of the piece.

Grade Limits for Merchantable B.

Defect.	**Up to 25 square inches Sectional Area.**	26–99 square inches Sectional Area.	**100 square inches Sectional Area and over.**
Wane	**If fluarised not to exceed one-quarter the dimension on which it occurs, or one-quarter the length; if untreated not to exceed one-eighth the dimensions or one-eighth the length**	If fluarised not to exceed one-quarter the dimension, or 1½ or one-quarter the length; if untreated one-eighth the dimension or 1" or one-eighth the length	**If fluarised not to exceed one-sixth the dimension, or 2½" or one-quarter, the length; if untreated not to exceed one-eighth the dimensions or 1½" or one-eighth the length**
Gum pockets on any face	**Not to exceed one 6 x ⅜ measured on the quarter in any 5 lineal feet**	Not to exceed one 7 x ½ measured on the quarter in any 5 lineal feet	**Not to exceed one 9 x ¾ measured on the quarter in any 5 lineal feet**
Gum veins, no pockets on any face	**Total length one-third; individual length 4 feet**	Total length one-third; individual length not to exceed 4 feet	**Total length one-half; individual lengths 6 feet**
Gum veins, associated with limiting pockets on any face	**Total length one-sixth** ..	Total length one-sixth ..	**Total length one-quarter**
Knots	**One tight intergrown up to 1½" diameter, or one other up to 1" diameter if not through, in any 5 lineal feet**	One tight intergrown up to 2" diameter, or one other up to 1½" diameter if not through, in any 5 lineal feet	**Tight intergrown knots, or one other up to 2" diameter if not deep in any 5 lineal feet**
Grub holes ..	**Well distributed** ..	Well distributed ..	**Well distributed**

Allow any single defect and, in addition, a combination of other defects equivalent to one of the above, provided that the combination of defects on all faces at any section will not materially affect the strength of the piece.

The portions in heavy type have been drawn up from a study of parcels of timber in the field. Those in lighter type have been deduced from these. All Karri specifications to be regarded at this stage as trial specifications.

(*d*) Karri Heavy Scantling.

Grade limits for larger sizes in karri have been drafted in the same way as in jarrah. It is desired to emphasize, however, that observations on larger sizes in karri were confined to mine guides, together with 86 pieces of fluarised* karri in sizes 15 inches x 8 inches, 12 inches x 8 inches, and 12 inches x 10 inches, of length up to 30 feet, and ten beams 12 inches x 12 inches x 45 feet. As the grade limits for scantling up to 6 x 4 are only given as trial limits, the limits for grades for larger sizes partly derived from these must definitely be regarded in the same way.

The grade limit for larger sizes obtained in this instance from field observations is based on a consideration of the 86 pieces mentioned above which were cut for the local market. The limit is, therefore, merchantable B.

All grade limits are given in Table 10, showing derivation of grade limits for scantling sizes and the one grade limit, based on field observations, of merchantable B for sizes over 100 square inches.

Specifications for inclusion in the list of recommendations have not been drafted from these grade limits as with jarrah. This could not be safely attempted till suggested trial grade limits have been tried out on larger quantities of material.

The same remarks with regard to general qualities and location of defects apply to karri as with jarrah.

2. Flooring.

The relative importance of flooring with respect to other classes of product can be seen from Diagram No. 2. Flooring represents approximately 15 per cent. of the total production of all timber. From rather scanty data available, it would appear that in recent years approximately 40 per cent. of this quantity has been marketed overseas, 10 per cent. in the eastern States, and 50 per cent. within Western Australia. Wood-block flooring is of relatively small importance on the local and interstate market at the present time, but is becoming of increasing importance on the overseas market. Practically the whole of the flooring cut is jarrah, and all discussions refer to this timber unless specifically stated.

(*a*) Flooring Strip.

Introduction.—The grading of flooring has been receiving considerable attention in all States of the Commonwealth in order that the qualities of Australian flooring timbers might be standardized. Definite progress has been made, and several States have agreed to provisional specifications setting out a certain number of grades and defining the limiting defects within the grade.

---

* Fluarising is a patented process of timber preservation used in Western Australia. It consists essentially of impregnation with solutions of sodium fluoride, sodium dinitrophite, and arsenious oxide.

The Committee on Grading of the Western Australian Sawmillers Association has been considering the problem in relation to local timbers. Draft specifications have been forwarded by the committee to saw-millers generally for comment, and amended grades have since been drawn up by the secretary. Since these earlier specifications were distributed, few comments have been received. The present trade conditions are cited as deterrents to adopting the proposals. Probably the chief reason for the lack of response regarding the suggested rules is that the economics of their effect on the custom of the trade have not been discussed, and the saw-miller is naturally disinclined to commit himself to a set of rules of which the effect on his practice is obscure.

The field work of 1932 was planned to show some of the economic factors. It aimed at applying the latest suggested specifications for flooring to machine runs of milled boards at metropolitan yards, and thus to determine the distribution of qualities. These data would demonstrate, in a practical way, the meaning of the grades, and permit the saw-millers to judge their worth upon the results of a practical application. Without the aid of the draft specification prepared through the deliberations of the Standards Association and the Western Australian Committee on Grading, progress to this stage would not have been possible in the time available.

It is very necessary to stress, particularly with regard to flooring, that the past year has been an abnormal one, resulting generally in a buyers' market with consequent tightening up in quality. This factor has rendered difficult correlation of detailed observations on comparatively small parcels with normal trade practice. A further difficulty has been found in that observations on stacks being demolished represent not present trade practice but that of a few years ago.

The problem has been approached by considering the general grading of flooring boards, and the boards intended for export have not been separated from those intended for local trade. The quality of boards at present produced for the English or European markets is different from that produced for the eastern States and again from that for local trade. The present tendency is to produce for one market at the one time, and thus some boards suitable for other markets are probably lost. Grading rules could be prepared to permit these practices and allow all grades to be produced simultaneously, and thus raise the recovery from the same logs. The various markets could be supplied by sorting the general products, this specialized phase of production being known as "grading."

In the past, boards have been placed in seasoning stacks straight off the saw before a consistent examination of their quality has been made. This absence of grading was general when markets were active. During 1932, many of these stacks have been demolished to reduce stocks and in trying to meet the exacting demands of a buyers' market, the proportion of rejects has been, in many instances, alarmingly high. The consequent losses have made the necessity for grading very evident,

and at some mills instructions have now been issued to prevent the stripping out of material of poor quality. Obviously it is not economical to store boards for years, and then find that they are too defective to be marketable. The time for grading is before stacking. With suitable rules applied during the building up of new stocks, the various mills could place themselves in a sound position and be able to supply requirements for different qualities easily and as a normal trade practice. The need for grading of flooring is now therefore apparent, but the grade limits have yet to be determined.

Investigations on milled flooring.—In the past few years, the depression in the building trade has had a pronounced effect on the grading of flooring. Whereas the timber merchant could command a ready sale in times of active demand for grades containing a range of qualities with appreciable defects, the trade is now restricted. The qualities of flooring have had to be revised to meet these changed conditions.

The grade names of flooring have remained unchanged while the qualities have been altered. Trade practice is to produce two named grades, "firsts" and "seconds," while a third class "reject flooring" is sold, consisting of milled boards containing some defects which exclude them from "seconds." We have been unable to find any specification written to describe the qualities of flooring produced. The grader usually receives oral instructions from the shop foreman, and his grading practice is altered if, and when, complaints as to quality are received.

Arbitrary divisions within the trade grades are not uncommon, such as "specially selected firsts" and "good seconds." These are sorted out to meet the demands of exacting clients, and are not considered as grades for normal production. Their existence, however, demonstrates that grades in addition to "firsts" and "seconds" can be produced when the demand arises.

Grade qualities.—As no definite written specification existed to show the limits under which the present trade grades were produced, the first step in the observations on milled flooring was to examine the quality by referring to draft specifications. Fortunately, the proposed grading rules to cover milled jarrah flooring have been prepared by the Western Australian Committee on Grading, and were available as a standard of reference. These grading rules resulted from a series of drafts, comments, and re-drafts of suggested rules. Their form to 26th April, 1932, and as used in these present field studies, is given in Appendix 2 (*b*).

The grade names "ballroom," "first quality house," and "reject" are, at this stage, not to be considered as recommendations. They are used throughout this discussion to distinguish the grades proposed from those produced under present trade practice. When satisfactory divisions of quality in present mill-run flooring have been determined, the question of appropriate names can be finally discussed.

The above grading rules were first applied to 1,000 pieces of 6 x 1 milled flooring which had been produced as "first class" quality for normal trade conditions. An equivalent quantity produced as "first class" 6 x 1 flooring for present trade conditions was examined at a second yard. All pieces have been re-graded according to the limits of the above rules, and the results are shown in Table 11.

TABLE 11.—SUMMARY OF RE-DISTRIBUTION INTO GRADES OF "FIRST CLASS" FLOORING FOR NORMAL AND PRESENT TRADE CONDITIONS.

Regrade.	Percentage of pieces in parcel of "First Class" Flooring produced for—			
	A. Normal Trade Conditions.		B. Present Trade Conditions.	
Ballroom grade—				
Clear	28·0		51·5	
Very small defects	9·3		18·4	
Approaching limit	10·3		10·9	
	——	48	——	81
House grade—				
High quality	20·6		10·5	
Definitely within grade	17·7		5·3	
Approaching lower limit	10·0		3·0	
	——	48	——	19
Reject		4	Under 1	

Considering Table 11, it is evident that—

(1) "First class" flooring comprises a mixture of qualities.

(2) The standard of "first class" flooring has been raised considerably to meet present trade conditions.

(3) The present standard of "first class" flooring approaches that proposed as ballroom grade. This is shown by the fact that 81 per cent. of "first class" is graded as ballroom, and 10.5 per cent. as close to the grade.

"Seconds" produced for present trade conditions were examined in a similar way. The percentage re-distribution into the above grades, based on a classification of 341 pieces of 6 x 1 "seconds" was as in Table 12.

This table shows that mill "seconds" comprise a mixture of qualities, and that the range of qualities is wide. Some of the material could be improved in quality by docking out defective portions. The amount of docking that would be practised depends on the grade limits adhered to. The material under the heading of docking in Table 12 illustrates the resulting distribution if docking practice is governed by the limits of the proposed rules.

If the proportions of "firsts" and "seconds" sold on present markets were known, the data in Tables 11 and 12, assuming them to represent typical conditions, could be applied to these proportions to determine the distribution of the proposed "ballroom" and "house" grades in the normal production of flooring.

TABLE 12.—SUMMARY OF RE-DISTRIBUTION INTO GRADES OF "SECONDS" FLOORING PRODUCED FOR PRESENT TRADE CONDITIONS.

Regraded as—	Percentage of pieces in parcel of "Seconds."	
Ballroom grade—		
Clear	..	
Very small defects	2·9	
Approaching grade limit	6·2	
	——	9
House grade—		
High quality	10·2	
Definitely house grade	26·1	
Approaching grade limit	19·6	
	——	56
Reject	15·0	
Docking would raise the balance to—		
Ballroom grade	5·9	
Ballroom, approaching limit	0·6	
	——	6
House grade, high quality	6·2	
House grade	5·9	
House grade, approaching limit	1·5	
	——	14

Distribution of qualities in machine runs.—Supplementary data regarding the distribution of grades in mill-run flooring and experience in applying the suggested rules were obtained by observing continuous runs at flooring machines. By recording the grade, as designated by the mill-grader, and the re-grade according to the limits of the proposed rules, the distribution of the mill grades and the new grades was determined. Table 13, based on a machine run of 1,870 pieces of 6 x 1 flooring at one mill, summarizes the results:—

TABLE 13.—GRADING OF MACHINE-RUN FLOORING BY THE MILL GRADER AND UNDER PROPOSED SPECIFICATIONS.

Mill Grades.	Percentage of Run.	Regrades.	Percentage of Run.	
Firsts	16	Ballroom grade—		
Seconds	63	Clears	9·1	
Docking	12	Very small defects ..	3·8	
Rejects	9	Approaching limit ..	4·7	
			——	18
		House grade—		
		High quality	14·0	
		House grade	33·9	
		Approaching limit ..	22·5	
			——	70
		Rejects		12

In the above regrading, boards needing docking to raise to house grade have been shown as approaching the limit, but no allowance has been made for boards that could be raised to ballroom grade by

docking. Boards needing docking could not be booked separately owing to the high rate of production. Probably one-third of the boards shown as approaching the limit could be raised by docking to house grade. The remaining two-thirds on the limit of the grade includes all doubtful pieces, and some of these might have been rejected on a strict interpretation of the specification.

All available data on milled flooring have been considered in estimating the distribution under suggested specifications when docking is practised. Briefly, the results of the detailed examination of mill grades (in Tables 11B and 12) were applied to the mill grades on the left-hand side of Table 13, and the figures so obtained were compared with the distribution on the right-hand side of Table 13. Adjustments were then made as considered necessary. Table 14 shows the approximate distribution into the suggested grades when docking is practised and governed by the proposed limiting defects.

TABLE 14.—APPROXIMATE DISTRIBUTION INTO GRADES OF MACHINE-RUN 6-INCH x 1-INCH FLOORING AFTER DOCKING.

—	Percentage of Run.	
Ballroom grade—		
Clear	10	
Very small defects	13	
Approaching limit	7	
	—	30
House grade—		
High quality	13	
Definitely house grade	22	
Approaching limit	20	
	—	55
Rejects		15

In view of the high percentage of rejects, which vary in quality and utility, the advisability of limiting the defects to eliminate boards that are of no use for any purpose should be seriously considered. The possibility of receiving boards that are totally useless must seriously handicap the sale of "reject" flooring. By placing even broad limits on reject flooring and calling it, say, "common," the enhanced value of this class of material could be expected to outweigh all extra costs involved in sorting.

A machine-run of 5 x 1 flooring was observed using a similar procedure. The quality of this flooring was so obviously below the general quality of flooring, and contained such an unnecessary percentage of pieces that should never have been put into a flooring stack, that conclusions regarding the distribution cannot be accepted as fair average indications. It seemed that the material had accumulated after highest quality pieces had been picked out for other markets, and had been forwarded to the metropolitan yard to produce what it could. Such practice, though desirable from some points of view, is inordinately expensive when rail freights are considered. The mill grader rejected 26 per cent. of the run, and 46 per cent. was below the "house grade"

suggested in the specifications. A discriminate use of the docker would probably have resulted in the production of 15 per cent. ballroom and 50 per cent. house grades, leaving 35 per cent. as rejects. On these rejects, the costs of loading, freight, unloading, and machining have been met, and no commensurate return could be expected. Some pieces, useless for any purpose, would need to be destroyed, and the total loss on these would be avoided by grading the timber before it left the saw-mill or seasoning yard. On the remainder of the 35 per cent. rejects, the costs of transport and machining are the same as for the highest grade, and the burden of their production cost is borne by the higher grades if the price of rejects is too low. By proper grading, it would be possible to reduce the proportion of rejects and permit the more profitable production of flooring in general.

The distribution within this parcel, namely, 15 per cent. ballroom, 50 per cent. house grade, and 35 per cent. rejects, probably represents a distribution under the worst practical conditions.

Application of percentage restriction of limiting boards in grades.—The application of grade limits during a machine run of flooring was found to be reasonably easy. The restrictions of limiting boards, however, by such clauses as "not more than 20 per cent. shall approach the grade limit," cannot be applied during the course of normal production unless the limiting boards are tallied. However, they can be applied at time of loading for delivery or in the event of an inspection being called for. Their provision may have a profound effect on the number of pieces that can be admitted into a grade. In order to test the effect of the clauses suggested to limit the number of border-line boards, the following clauses were applied to the field data:—

(*a*) *In Ballroom Grade.*—80 per cent. shall be clear, and up to 20 per cent. may contain small defects.

(*b*) *In Ballroom Grade.*—Up to 20 per cent. of the boards may contain defects approaching the limit.

(*c*) *In House Grade.*—Up to 20 per cent. of the boards may contain defects approaching the limit.

Applying clause (*a*) to column A of Table 11, it is deduced that if 28 per cent. of the whole parcel is clear, then only 7 per cent. of the parcel with very small defects will be admitted into ballroom grade. Thus 2.3 per cent. with very small defects and 10.3 per cent. with defects approaching the grade limit, will be removed from their present allocation in ballroom grade and placed in the next lower grade. By applying clause (*b*) to Part A of Table 11, 20 per cent. of the 47.6 per cent., i.e., 9.5 per cent. of the parcel, would be admitted with defects approaching the ballroom grade limit. Thus the clause would reject 0.8 per cent. of the parcel at present allocated to the suggested ballroom grade. Clause (*c*) applied to the same data would reject 0.3 per cent. of the parcel now included in house grade.

In Part B of Table 11, clause (*a*) would reject 5.5 per cent. containing small defects and 10.9 per cent. containing defects approaching the limit from the portion of the parcel now graded as ballroom. Clause (*b*) would allow more boards to approach the limit of ballroom than at present admitted. Clause (*c*) would also allow a slight increase of limiting boards in house grade.

In Table 14, clause (*a*) would throw out 10½ per cent. containing small defects and 7 per cent. containing limiting defects from the 30 per cent. now graded as ballroom. Clause (*b*) would throw out 1 per cent. of the boards now classed as approaching the ballroom limit.

The pieces rejected by the application of the above clauses to material graded as ballroom would be included in house grade; those rejected from house grade would be classed as "reject" flooring unless their grade could be raised by docking. The results of the application demonstrate the importance of the limiting clauses and the need for carefully determining the percentages to be adopted.

The above discussion indicates that a clause providing for 80 per cent. clear in the ballroom grade would reject a large percentage of pieces containing small defects yet above the limit of the grade. The clause "not more than 20 per cent. shall contain defects approaching the grade limit" gives a better measure of present trade practice, but, as pointed out in the discussion on similar clauses with respect to scantling, such a clause can only be satisfactory when a higher limit is written to define just what is meant by "approaching the grade limit." It has been decided to recommend the use of a similar clause to that used for scantling, namely, "Not more than 10 per cent. shall be on the grade limit."

The occurrence of defects.—During the investigations on milled flooring, many thousands of pieces were classified. The field data were so recorded that the frequency of occurrence of any defect, besides its type and significance in relation to the proposed grades, could be shown. Sample records are set down in Tables 34 and 35 (Appendix 3).

Notes on specification as drafted.—As a result of the experience gained during the grading of mill flooring, the following suggestions for improving the rules are submitted.

Though the limits suggested in most cases were easy to apply, it became very evident that simple provisions are necessary, especially when fast-feed machines are operated. Rapid decisions have to be made, and judgment as to equivalent defects has to be exercised frequently.

The grades are discussed in sequence.

Ballroom Grade.

The reference to exceptionally light-coloured boards could not be interpreted consistently in these studies. Its deletion is suggested.

(*a*) *Grub holes.*—The limitations of the diameter of holes to 1-16 inch is considered a little severe, and some allowance for an occasional hole of large diameter is recommended. "One ⅛-in. diameter hole per 5 nominal square feet" is suggested.

(*b*) *Skip on the back.*—The allowance for skip is recommended for increase to "3 square inches for each inch nominal width, but not reducing the bearing surface by more than one-fifth at any place."

House Grade.

The allowance for surface checks cannot be interpreted satisfactorily. In a finished floor, the surface checks are never as

conspicuous as joints, especially if shrinkage takes place. Prescribing limits for seasoning is much more important than limiting surface checks. It is suggested that they be included as an equivalent defect with their extent not defined separately.

The deletion of the specification for skip is recommended. Reliance could be placed on the discretion of the grader in allowing defects on the back which will not affect the perfect laying or strength of the floor.

Interim conclusions with respect to observations on milled flooring.

(*a*) With amendments as suggested immediately above, it is considered that the grade limits can reasonably be applied to cover the supply of two grades for the local market.

(*b*) The proposed grade limit of "ballroom" approximates closely that of the quality sold under present trade conditions as first class flooring.

(*c*) The proposed grade limit of "house" would reject 15 per cent. of material now sold as seconds, and in addition a further quantity of this material would have to be docked before it could pass the grade specification.

(*d*) The rejection of 15 per cent. now milled and sold as seconds together with further rejections which now take place during conversion, seasoning and manufacture, indicates that reject material is of sufficient importance to justify the creation of another grade. By exclusion of a few of the worst boards, the value of the parcels could be raised considerably.

Investigations on sawn flooring boards.—The grading of flooring should commence at the saw-mill on sawn boards. Once grade limits have been decided for milled flooring, the limiting defects should be brought to the attention of the sawyers to guide their cutting practice and to ensure that faults are eliminated before the expenses of handling are met.

The work on sawn flooring boards partly preceded and partly followed that on milled flooring. While the general methods of procedure for the whole study were being determined, some sawn flooring boards for overseas export, interstate export, and local trade were described in detail. These observations led to the formulation of a plan for the intensive studies on milled flooring discussed above, and these in turn were the foundation upon which studies of the distribution of grades in sawn flooring boards were based.

Export flooring.—Flooring is exported in sizes 3 x 1, 4 x 1, and 4 x 1¼. Some orders specify that the material shall pass a Forests Department inspection before shipment, but the percentage of the total flooring exported that is subjected to official inspection is very small.

Present specifications—Export flooring.—Typical specifications governing the quality of flooring boards for export are as follow:—

1. *Sawn Selected Jarrah Board Strips.*—To be prime quality, shipping dry, cut full to size, and suitable for the manufacture of flooring provided that one face is clear of all defects, slight defects on the reverse side not to be objected to.
2. *Sawn Selected Green Jarrah Flooring.*—To be suitable for flooring strips.
3. *Seasoned Jarrah Boards (for Adelaide).*—To be first class prime selected board quality free of all defects suitable for running into flooring

About 600 boards in a consignment for the English market were observed during loading. Specification No. 1 formed the basis of their supply, and it was concluded that this specification was strictly adhered to. In 429 pieces of 4 x 1, 92.5 per cent. were free of all defects; and in 162 pieces of 3 x 1, 95 per cent. were free of all defects. The rest of the pieces, although containing some defect, were clear on one face. The quality of these boards approached the best that could be produced.

No estimate could be made at the time of inspection regarding the proportion of the above class of material that would be found in the ordinary production of boards.

Flooring for interstate export.—The loading of 4 x 1 strip flooring supplied nominally under specification No. 3 was observed at one mill. A detailed examination could not be made, but from general observation it was evident that the boards were not even free of all defects on one face and two half-edges. Probably 20 per cent. were below the latter requirement, but with docking, the loss would be small. Gum veins up to 1-16 x 12 were allowed on the better face.

Flooring for stock and for local trade.—Flooring boards for local trade are produced in 4 x 1, 5 x 1, and 6 x 1 sizes. There is a general understanding as to what board quality means, but no definite instructions for the sawyer's guidance have yet been issued regarding limitations of defects. During stacking, the boards are now subjected, due to to the exigencies of a buyers' market, to a form of grading, the standards being governed by the use anticipated for the particular boards.

At one mill, parcels of 100 boards each of 4 x 1 and 6 x 1 were classified into quality groups. Of boards examined, 25 per cent. were free from all defect, 23 per cent. free from defect on one face and two edges, and the balance (52 per cent.) showed defects on both faces. Owing to the limited number of observations, results can only be taken as an indication of quality of boards being cut.

Distribution of qualities in a sawmill run.—The above observations were followed by investigations at city yards already covered, and then by further work at bush sawmills in an attempt to grade the sawmill run of boards into the proposed qualities. At one mill, a complete grading study was made during two and a half days' running, during which time 521 cubic feet of boards and 192 cubic feet of linings were produced. These quantities were graded on the proposed grading rules for jarrah flooring drafted 26th April, 1932 (see Appendix 2 (*b*)), in so far as they could be applied to sawn material. The results are given in Table 15.

The part of the table referring to inch boards shows that 39 per cent. were ballroom grade, 59 per cent. were house grade, and 2 per cent. were rejects. As the mill was operating in only medium quality bush, it is not expected that the distribution represents the best conditions.

A study along similar lines was conducted at another mill in which 125 cubic feet (330 pieces) of boards and weatherboards were produced. The grading according to the limits defined previously resulted in 46 per cent. being classed as ballroom grade (31.6 per cent. clear, 4.2

TABLE 15.—DISTRIBUTION OF BOARDS AND LININGS INTO GRADES AT MILL NO. 4.

Based on 2½ days' observation and a production of 713 cubic feet.

Size.	Average Length.	Ballroom Grade. Clear.	Ballroom Grade. Very Small Defects.	Ballroom Grade. Approaching Limit.	House Quality. High Quality.	House Quality. Within Grade.	House Quality. Approaching Limit.	Reject.	Total.
(Inches.)	(Feet.)	Number of Pieces.							
3 x 1	10·5	48	31	26	41	114	39	9	..
4 x 1	10·9	60	35	35	35	81	17	1	..
5 x 1	10·6	19	11	11	12	35	3	..	..
6 x 1	10·3	25	18	16	29	60	35	9	..
7 x 1	9·9	9	9	13	13	27	9	..	..
9 x 1	12·3	1	..	..	..	3	..	..	..
Total for inch boards ..		162	104	101	130	320	101	19	937
Distribution per cent. ..		17·3	11·1	10·8	13·9	34·2	10·8	2·0	..
Totals for 6 x 1½ to 8 x 1½ boards		55	29	28	41	76	7	..	236
Distribution per cent. ..		23·3	12·3	11·8	17·4	32·2	3·0	..	..
Total for 4 x ¾ to 7 x ⅝ linings and weather-boards		143	81	63	90	166	43	12	598
Distribution per cent. ..		23·9	13·5	10·5	15·0	27·7	7·2	2·0	..
Totals—All pieces ..		360	214	192	261	562	151	31	1,771
Distribution per cent. ..		20·3	12·1	10·8	14·8	31·8	8·5	1·7	..
			43·2			55·1			

per cent. very small defects, and 10.3 per cent. approaching the limit); 51 per cent. house grade (14.5 per cent. high quality, 28.2 per cent. definitely house grade, and 8.5 per cent. approaching the limit); and 3 per cent. rejects.

From these data and those in Table 15, it is estimated that mills in medium bush could produce 35 per cent. ballroom and more than 60 per cent. house grade in an ordinary run of board sizes.

Recommendations.

Number of grades and their limits.—The number of grades to be recommended is dependent on the economic factors of distribution to various markets. When exported overseas, flooring boards compete with the best timbers in the world, and, owing to the freight and handling charges that must be met, the prices are so high that the timbers can find use only in the luxury markets. The quality requirements are exacting, and it is definitely undesirable to forward boards other than highest quality. The overseas market therefore absorbs the highest quality produced. It is difficult to estimate the relative proportions of the total production of boards that reach the respective markets overseas, interstate, and local. From scanty data available, it appears that 40 per cent. of the boards produced are marketed

overseas, 10 per cent. in the eastern States, and 50 per cent. locally, but in reading these figures, it must be realized that they can give an indication only, being obtained under abnormal conditions.

The data in Table 15, relating to a mill operating in only medium class bush, show that only 28 per cent. of the mill run of inch boards was clear or contained very small defects. This mill could then evidently not accept trade with exacting overseas markets in proportion to its output of general boards. Mills operating in better bush would probably take a larger share of the trade with overseas markets.

As far as sorting and stacking are concerned, advantage lies in *reducing the number of grades to a minimum.* From the view-point of marketing, however, there are certain standards to be observed, and boards must be segregated into qualities. The marketing of qualities will be influenced by price margins.

The grade required for the overseas market will apparently correspond with the proposed ballroom grade. As far as the eastern States markets are concerned, these are obviously passing through a stage of transition, and it is impossible to predict their requirements. From the stand-point of the quality of timber which can readily be produced by saw-millers, it seems that the proposed grades of ballroom and house are satisfactory. If necessary, "house and better" could be supplied where a mixed grade is desired. When the requirements of these markets become more clearly defined, the proposed specifications can be suitably modified.

Seasoning of Strip Flooring Boards.

The most common practice in Western Australia is to air-season flooring boards. In the past, several companies have operated seasoning kilns, but the types of kilns selected have not all been the most economical, and have been handicapped by absence of proper handling facilities. Generally speaking, kiln design and kiln drying practice has not kept pace with modern developments, and the trade has been loath to accept as real the advantages attendant on latest methods.

The published literature now available on seasoning practice in relation to Australian conditions gives valuable guides to the obtaining of best results. The series of Trade Circulars issued by the Division of Forest Products, C.S.I.R., dealing with seasoning are:—

Circular No. 1.—Sound Practice in the Air Seasoning of Boards.
„ „ 2.—The Testing of Timber for Moisture Content.
„ „ 7.—Sample Boards: Their use in Timber Seasoning.
„ „ 9.—Electrical Moisture Meters: For measuring the Moisture Content of Timber.
„ „ 12.—Combined Air and Kiln Seasoning.

These are available free of cost, and outline the principles of importance to be observed in proper seasoning. The Forests Department of Western Australia has also issued two Bulletins:—

Bulletin 40.—The Seasoning of Western Australian Hardwoods.

Bulletin 45.—The Air Seasoning of Jarrah Flooring Boards.

If full advantage were taken of the information set out in these publications, it is felt that seasoning practice would be so improved

that the performance of the products in service would be considerably more satisfactory.

In the eastern States, particularly in Victoria, the growth of kiln seasoning has been phenomenal in the last few years. Kiln drying and re-conditioning are rapidly superseding air seasoning. The number of kiln installations has increased enormously, and the experience gained in their operation has resulted in the marketing of local timbers in a uniformly dried condition, frequently to a guaranteed moisture content. This kiln-dried timber can be supplied at the same moisture content throughout the year. Its markets are continually expanding, and at this stage it has almost completely replaced the Baltic flooring, and can hold its own against the best Australian competitors. The significance of these developments to Western Australia is very important.

Saw-millers represented on the Grading Committee are of the opinion that all reference to seasoning should be deleted from specifications. Their chief objections to a clause limiting moisture content are—

1. Testing on present methods is impracticable.
2. Moisture content may change after supply.
3. Any safe moisture content that could be specified to cover saw-millers' interests would be useless from the point of view of supplying seasoned timber.

The chief intention relating to seasoning is that in grade specifications there shall appear a clause such as "the moisture content shall be within prescribed limits." The prescribed limits shall be specified by the purchaser when stating the grade to be supplied. This is the principal means of ensuring satisfactory performance in service and of maintaining the market for timber in face of competitive materials whose behaviour is more closely controlled. The substitution of a definite clause relating to moisture content of timber, to replace such vague requirements as "well-seasoned" or that the boards shall have been stacked for a prescribed period (irrespective of the site or the time of the year at which boards are supplied), is the only means of giving satisfaction.

The first objection to a moisture content specification that testing on present methods is impracticable, could be readily overcome in two ways, namely, by using sample boards in seasoning stacks or by testing moisture contents with electrical moisture meters. The sample board method consists, briefly, of placing short boards (end-coated to prevent abnormal drying) in the stack so that they can be removed and weighed periodically to determine their moisture content. By properly locating the boards throughout the stack the average conditions can be indicated. The development of electrical moisture meters is a revolutionary advance in drying practice. The instrument is capable of showing the moisture content of boards to an accuracy of 1 per cent. It is simple and rapid in its operation. It can be used to test the moisture content of several hundred boards in the time necessary to cut and weigh sample pieces. The instruments are manufactured in Australia, and are available at an approximte cost of £16. They are rapidly coming into use by saw-millers and timber merchants in the eastern States, and tests are frequently conducted at the request of

architects. By their use, the first objection concerning the inconvenience of testing moisture contents would be entirely removed.

The second objection, that the moisture content may change after supply, does not affect the question up to the named point of delivery. The clause in the specification can be so worded that the responsibility of the saw-miller ceases when the material passes from his hands, i.e., into a covered truck, or a ship, or a merchant's shed. The electrical moisture meter could be used to test moisture contents at the point of delivery named in the specification to protect the saw-miller from claims due to changes occurring after the parcel has passed from his control. Providing that reasonable precautions are taken, the moisture content of timber satisfactorily dried at the producing centre, will not change appreciably before it reaches its destination. Tests are now in progress to show the behaviour of kiln-dried flooring shipped from Melbourne to London. Moisture contents have been tested just prior to loading, and they will be tested again on unloading. A previous test on similar material showed that the change is not greater than 1 or 2 per cent.

The third objection is that any safe moisture content specified to cover saw-millers' interests would be useless for ensuring the supply of seasoned timber. This must be admitted on present practice. The question is thereby raised as to whether present practice is designed to supply the real needs of the customer, and whether emphasis is not placed on wrong aspects. All efforts to eliminate inherent defects in flooring are wasted if similar care is not expended on proper seasoning. A floor of clear boards improperly seasoned is liable to shrink, possibly warp, and open at the joints after laying, and become more unsightly than a floor perfectly seasoned and stable, containing surface defects. Unless stability is assured, the value of selection and perfect milling is lost. Studies have been initiated in the principal cities of the Commonwealth to determine how dry timber should be for different uses in these cities. The results, when available, will strengthen the foundation upon which satisfactory drying practices can be built.

(b) Wood Block Flooring.

Introduction.—During the past twelve months, favorable conditions have created a strong demand for wood block flooring, mainly in Great Britain and Europe. Several factors resulting in low prices have been operating, principally low production costs, a favorable exchange, forced realization of heavy stocks of seasoned boards, and ability to produce an appreciable quantity as a by-product. Preference for Empire goods has also probably influenced the demand for Australian timbers.

The absurdly low prices sometimes realized for block flooring compared with other standard products can be gauged when the quality, small section, and amount given away in oversize are considered. As an illustration, let us consider the cutting down of a perfect sleeper into block flooring. The oversize in a sleeper is ¼ inch x ⅛ inch. In block flooring, approximately 3 inches x 1 inch nominal cross section, the same allowance is made. Allowing for loss only in saw kerf and overmeasure, the super. contents lost in cutting down approach 30 per cent. Further loss would be met on account of quality, a very moderate estimate of such loss being 20

per cent. Thus the total loss in converting the sleeper to block flooring would be at least 50 per cent. Therefore, unless the value at the mill of block flooring is at least double the value of sleepers, it may be more profitable to cut sleepers. In addition to extra cost of sawing the smaller section, block flooring has to bear the added cost of sorting to lengths, bundling, extra rail freight on account of oversize, and generally extra rail freight because of the necessity of shipping small parcels at Fremantle.

The position would be further aggravated by a possible fall in the exchange rate, as prices are nearly all on a c.i.f. and e. basis.

Whether sawn block flooring is produced as a by-product or as a major item of production, it is certain that with a reasonable specification drafted with a knowledge of buyers' requirements and producers' ability to supply, the buyer can afford to pay full value for goods received, and the producer could fulfil requirements and at the same time reduce to a minimum the quantity of unsatisfactory material going forward.

Discussion of field data.—Typical existing specifications call for material free from all defects, and cut full with allowances in length for docking. There is no definite interpretation of "cut full," and the quality varies considerably from "free from all defects." Generally, the aim is to supply pieces free of defects on one face and two edges, but a strict inspection would reject a small percentage below this standard. A considerable variation is also found in the extent of the defects allowed on the under face.

The following discussion is based on detailed observations at three mills producing jarrah block flooring, on earlier observations at other mills, and on correspondence with a large English flooring company. The correspondence arose through a draft specification, prepared by the Western Australian Forests Department, being forwarded for comment to the London agents of a Western Australian sawmilling company. Constructive criticism and a revised specification were received from England. This is given in Appendix 2 (*c*). A further revised specification to cover the supply of jarrah strips for the production of wood block flooring has now been drafted, and is shown in full in the general set of recommendations in Part IV. Points raised are discussed in detail below.

1. *Number of grades.*—The use of wood block flooring in floors ranging from factory to ballroom might indicate the possibility of two grades. Some blocks, probably used in factories, are not tongued-and-grooved nor end-matched. The presence of very small defects in the top face of the blocks in such a floor would not affect the utility. Unless, however, a fairly wide difference can be shown between the costs of the laid floor in factories and in ballrooms (apart from extra finish), it is not considered that two grades would be justified. The two grades would be very close to each other, as only very small defects would be allowed, and the effect on laid costs of the slightly lower price of the lower grade would not be appreciable. It is considered, therefore, that there would be little sale for the lower grade, and only one grade is recommended. With machined blocks, however, two grades might possibly be attempted, as a very considerable price reduction could be offered and grading can be very definite on the finished block.

2. *Grade limit for quality.*—A grade limit "clear all round," as named in some present specifications, could be maintained only by rejecting a considerable percentage of material at present being accepted. If blocks are free of defects on one face and adjacent half edges, small blemishes on the lower half edges and other face should be no detriment. Classification of parcels of blocks at three mills are shown in Table 16.

TABLE 16.—CLASSIFICATION OF WOOD BLOCK FLOORING AT THREE MILLS.

Mill.	Percentage of Production in the Quality Groups.		
	Clear all round	Clear on one face and two half edges.	Other.
	%	%	%
A	71	16	13
B	75	13	12
C	74	18	8
Mean	74	17	9

This classification is based on a detailed examination of 1,600 pieces. Except in the case of one parcel of 265 pieces, these were straight off the saw. A small percentage showing more serious defects would undoubtedly have been rejected in bundling. The 256 pieces mentioned were ready for bundling.

A detailed classification according to type of defect in 1,000 pieces examined at one mill resulted as shown in Table 17.

TABLE 17.—PERCENTAGE OCCURRENCE OF DEFECTS IN WOOD BLOCK FLOORING AT MILL NO. 3.

Quality Group.	Per cent.	
Clear		74
Clear on one face and adjacent edges, but showing on lower half of edges or other face—		
Sap	7·3	
Gum, 6″ and under	4·4	
Gum, over 6″	2·2	
Tight knots, ¼″ diameter	1·9	
Tight knots, over ¼″	0·8	
Pinholes	0·5	
Grubholes	1·4	
	——	18
Containing defects on better face or adjacent half edges—		
Gum, through, not exceeding 3 x $\frac{1}{16}$	1·0	
Gum, through, exceeding 3 x $\frac{1}{16}$	1·5	
Tight knots, ¼″ diameter	1·1	
Tight knots, greater than ¼″ better face	0·5	
Grubholes	0·4	
Pinholes, up to 2 per lineal foot	0·5	
Pinholes, over 2 per lineal foot	0·2	
Docking defects	1·3	
Other defects	1·1	
	——	8

A specification requiring one clear face and adjacent edges clear would reject approximately 9 per cent. of the pieces at present being supplied. Docking would probably permit the recovery of half of these rejects. Such a specification would, therefore, admit 96 per cent. of present production at this mill.

A specification allowing tight knots up to ¼-in. diam. on the better face (which would probably be allowed even if specified clear), gum up to 3 x 1-16th. and through pinholes up to two per block would reject 5 per cent. Allowing for a recovery of half of these after docking, such a specification would admit 97.5 per cent. at this mill.

Correspondence with England indicates that a clean face is absolutely essential, and this has been provided in the recommended specification. In this connexion the English flooring company states—

> "It must be kept clearly in mind that the strips are required to produce perfect flooring and toleration of defects which could not be eliminated in process of manufacture would only result in cramping the outlet for the finished flooring in this country."

Short notes are given below on the various points raised in the specification.

Sap.—Sap limited to the back and half edges is considered to be no defect. With regard to sap, the English flooring company states—

> "The presence of sap in any form is undesirable, but if it is confined to the underface and does not come nearer than ½ inch of the top face it might be tolerated in not more than 5 per cent. of the strips.

At two mills visited attempts were being made to supply free of sap, only an occasional block showing this defect. At the third mill, where full advantage was being taken of an allowance for sap on the back, about 7 per cent. showed sap. The allowance for sap thus permitted the production of 7 per cent. more pieces from the same material, and is, therefore, a very important consideration. Uniformity in this item would allow production of a sufficient number of extra blocks at the first two mills to balance the number rejected by a strict application of the recommended specification.

Gum.—Regarding the allowance suggested for gum veins, the flooring company replied that, on the lower ½ inch of the edges and in the underface small tight gum veins could be allowed, but not in more than 10 per cent. of the pieces, and further stated that—

> "Gum veins are an undesirable feature, and even on the underface of the blocks they are looked on with suspicion by the ultimate purchaser of the finished blocks. We think it desirable that the question 'small tight gum veins' should be more clearly defined as to actual lengths and widths of such veins."

When aiming at a clear face, it is impossible to produce a very large percentage showing short gum veins on the back. At the third mill, only 4.4 per cent. showed gum veins under 6 inches, and 2.2 per cent. showed gum veins over 6 inches. It is considered that gum veins should be limited to two-thirds the length of the block. A gum vein the full length of the block would be considered a serious defect. If cutting is in 9-in. multiples, the limiting length would be 6 inches, and in 12-in. multiples it would be 8 inches.

While only 4.4 per cent. showed gum under 6 inches at *Mill No.* 3, material from poorer bush would show a larger percentage with this defect. An examination of over 2,500 machined blocks in a parcel shipped to South Africa from another mill showed 4½ per cent. of the finished blocks with gum under 6 inches. These blocks were produced by docking suitable material from low-grade stock, so that the percentage showing defects would approach the maximum to be expected. A percentage of 4½ in the finished blocks showing gum under 6 inches indicates that at least 12 per cent. of the strips from which the blocks were produced showed gum.

Pinholes.—The suggestions of the English flooring company regarding pinholes are that, on the lower ½ inch of the edges and the underface, pinholes may be allowed not exceeding 1-16th inch in diameter and not more than two in any lineal foot and in not more than 5 per cent. of the pieces. They further state that—

> "With regard to pinholes, these are very undesirable and should be strictly limited to 5 per cent. of the pieces if they are to be tolerated at all."

An explanation of the nature of pinholes might result in an increased allowance on the back. Four pinholes should be no worse defect than one grub hole ¼-in. diam. If more numerous than this, one or more would probably show on the face and would condemn on the modified specification.

General quality of timber.—Pieces described in the field studies as clear were free from visible defects, but no account was taken of the general quality of the timber. A considerable variation would be expected in the wearing quality of the wood from piece to piece, as wood tending to overmaturity was mixed indiscriminately with prime quality timber. It is thought that some test of the wearing quality should be made to show whether selection should be attempted on the basis of wearing qualities. Selection would probably be difficult, but valuable, as a percentage of overmature pieces in a floor would probably limit the life of the whole floor.

Direction of cutting.—The flooring company desired to specify that not less than 50 per cent. be quarter sawn, as this conformed to their estimate of the proportion in present shipments. Unless back- and quarter-sawn material are sorted at some stage in manufacture, there appears to be no reason for specifying the direction of cutting. To apply such a clause, material would need sorting at the mill to adjust percentages. Observations on direction of cutting in crossarms are interesting in this connexion.

Percentage allowing defects.—The flooring company in their specification suggest a percentage limitation for each defect. In practice, this could be applied only by tallying each defect separately. From parcel to parcel, the occurrence of any particular defect might vary considerably. If the limitation was placed instead on the total number showing defects, these variations would tend to balance up, and supply within the specification would be simplified. The placing of, say, a 5 per cent. limit on sap and 10 per cent. on gum would be purely arbitrary. Occurrence of gum in 5 per cent. only would be a justification for a slightly higher percentage of other defects.

The suggestion of 70 per cent. clear and 30 per cent. showing defects on the back or half edges is intended as a protective clause as explained in the discussion on scantling grades. In an ordinary mill run produced within the limits of the specification, it is thought that defects would occur in about 20 per cent. of the pieces, but varying from 10 per cent. to 30 per cent. An allowance up to 30 per cent. would permit production of the grade with reasonable supervision, and at the same time would protect the buyer from being supplied an abnormal percentage containing defects. The position is altogether different from that for strip flooring, in which defects are allowed on the face. With wood block flooring, the difference in floors laid from parcels containing 10 per cent. defects on the back and 30 per cent. defects on the back would be negligible. To avoid this variation, it would be necessary to specify not more than 20 per cent. containing defects on the back and use this as a working clause. This would add to the difficulties of inspection without any great advantage.

Separate bill of lading for defective pieces.—In the specification suggested by the English flooring company, provision is made for a separate bill of lading for defective pieces. This would really mean the provision of two grades—a clear grade and a grade allowing defects on the back. If these were provided, the need for percentages would be entirely removed. As stated previously, however, it is considered that a second grade is not justified. A separate bill of lading would involve all the expense of careful sorting, and as pieces with defects on the back are considered as good as pieces clear all round, this expense is not warranted. The protective clause prevents the supply of an excessive quantity of defective material.

3. *Moisture content.*—In the tentative specification forwarded to England provision was made for supply alternatively—

(*a*) green;

(*b*) shipping dry, which means 25 to 40 per cent. moisture content; or

(*c*) air dried, which means under 25 per cent.

The clause (*b*) was included because, at the time, one firm was supplying to this nominal requirement. Subsequent investigations have shown that this requirement was not being adhered to, and a full consideration of present methods of production and shipping indicate that, if supplied "shipping dry," parcels may leave the mill with moisture contents varying from 15 per cent. to 60 per cent. Supplying within a range of 25 to 40 per cent. would be possible within reasonably regular production and despatch, but, with very little extra expense, it should be possible to comply with the third provision, "air dried, which means means less than 25 per cent." The main consideration should be to ensure supply of timber at a fairly uniform moisture content, and when aiming at 25 to 40 per cent. this is very difficult.

It is strongly recommended that no attempt be made to supply to a specification of under 40 per cent. Kiln-drying is the most reliable means of supplying to a uniform moisture content; but with timber such as jarrah, which does not collapse during drying, it is possible to supply

in a green or partly dried condition, relying upon kiln-drying being carried out by the purchaser. For this reason, we recommend that only green or air-dried timber to under 25 per cent. should be provided.

It is interesting to note that on a railage distance of 100 miles, a saving of 5s. to 6s. per load (50 cubic feet) in freight can be obtained by stripping for a short period till the moisture content drops to 25 per cent., compared with despatch in the green condition. In summer, with proper stripping, this reduction in moisture content would take place in about a month, but a longer period, depending on the location, would be necessary in winter.

4. *Size.*—The question of size raises many difficult points. Attempts to determine the buyers' exact requirements in this respect have not been very successful. Various points are discussed below in detail.

(*a*) *Number of nominal sizes.*—The following nominal sizes have been noted:—2 7/8 x 1 and 1¼, 3 x 1, 1¼, and 1½, and 4 x 1 and 1¼. Back-sawn material is usually supplied, but in some orders for the Continent quarter-sawn is specified. Block lengths also vary. The diversity of sizes and classes makes accumulation of stocks difficult. It is strongly urged that the co-operation of buyers be sought in reducing the number of sizes.

(*b*) *Relation of nominal size to cutting size.*—Some nominal size is necessary for purposes of calculation of contents and prices. The English flooring company believe that there is no need for a nominal size, and apparently want to base purchase on the final machined size. In suggesting a minimum size for air-dried timber of 3 3-16 inch x 1 1-32 inch for blocks finishing 3 inches x 7/8 inch, they state:—

> "It is necessary to be quite clear that the minimum size is one that will produce a block to the required finished size. In this connexion we want to make it clear that the suggested sizes are based upon air-dried timber containing under 25 per cent. moisture content. Unless the timber is dried to this degree it would not be possible for the importer on this side to agree to any definite minimum size other than that the strips should be cut sufficiently full to produce blocks of the required size after artificial kiln-drying and manufacture, and it would be the shippers' business to make any necessary allowance in cutting."

From the sawmiller's point of view, the supplying to a nominal size based on the final machined size is hardly reasonable, although the difference between the calculated quantity and the quantity supplied could be reflected in the price. To finish 3 x 7/8, the minimum green size would need to be 3¼ x 1 1-32, and the average size about 3⅜ x 1 3-32. Including the 3 per cent. allowance for docking, the sawmiller would be supplying 44 per cent. more timber than the calculated quantity. It is the minimum green size that is the primary concern of the sawmiller in material that has subsequently to be dressed. Around 3 x 7/8 the minimum cutting size green should be ¼ inch in width and 5-32 inch in thickness above the finished size, and the actual cutting size should be ⅛ inch and 1-16 inch respectively in excess of these to allow for variations in sawing. Actual variations found in practice are discussed in Part III.

(*c*) *Size of blocks when dried below the green condition.*—The flooring company suggest the adoption of a minimum size for boards under 25 per cent. moisture content, but this is impossible, since the size of a block is directly related to its moisture content. A block, undersize at the end of summer, could be oversize during the following winter, due to re-absorption of moisture, although still within the limit of 25 per cent. moisture content.

Actual records of size and calculated moisture content of sample boards in a seasoning stack can best illustrate the problem. The records for an average board during a twelve months' period are shown in Table 18. These are extracted from results of an air-seasoning study at a suburban yard on 7 x 1 boards in uncovered stacks:—

TABLE 18.—VARIATION OF WIDTH WITH MOISTURE CONTENT.

Date.	27.1.32.	10.2.32.	24.2.32.	24.3.32.	28.4.22.	28.7.32.
Size	7·37″	6·90″	6·79″	6·74″	6·78″	7·17″
Moisture content ..	77%	22½%	15%	12½%	14½%	23%

It must be obvious from this table that a minimum size is of value only when related to material in the green condition or to material thoroughly dried to a uniform moisture content before machining. The only size the saw-miller can control is the minimum green size. With all timbers, even when reasonable allowances are made for shrinkage and machining, a very small percentage would shrink abnormally and be below the desired size after drying. It is probably more economical to lose this small percentage than to cut all pieces sufficiently full to cover the few pieces that do shrink abnormally.

5. *Machining of blocks before despatch.*—The possibility of machining blocks before despatch has already been mentioned. By machining blocks, the production could probably be advanced from the status of a by-product to that of a major item of production. The manufacture could be combined with the production of milled strip flooring both for the local and export markets. Sufficient information is not yet available to permit a full discussion as a basis for a definite proposal, but the following points are considered:—

(*a*) *Class of material.*—It is generally recognized that a market exists overseas only for high-grade timber. The high freight charges can only be met by first-grade material. However high the grade is maintained in blocks straight off the saw, a certain amount of degrade occurs in seasoning and machining. This degrade material is difficult to sell. With machined products, the grading is final and definite, and no unsatisfactory material need be forwarded. Probable loss through damage in handling is estimated to be small compared with the loss due to degrade of sawn material in seasoning and machining.

(*b*) *Volume forwarded.*—Apart from losses due to degrade, it is estimated that at least 33 per cent. more volume has to be forwarded in the rough strips than in the finished block. Therefore, the sea freight charges should be reduced by one-third. There would be little reduction in freight charges before shipment, as planing mills would probably be situated close to the port of shipment.

(*c*) *Seasoning kilns.*—Drying to a uniform reliable moisture content is essential. This is best accomplished in seasoning kilns.

(*d*) *Changes in moisture content in transit.*—If dried to a slightly lower moisture content than needed at the point of consumption, blocks should give no trouble through slight absorption during transit. Victorian sawmillers are now shipping machined flooring to England. A small consignment tested before shipping and re-tested on arrival showed an increase of only 1 or 2 per cent. in moisture content. This small difference could be covered by slight over-drying before shipment. Moreover, dry stowage can be obtained for the comparatively small parcels shipped.

(*e*) *Number of sizes and patterns.*—The number of sizes now ordered is a serious disadvantage in standardizing production, and the number of patterns is a further complication. By standardizing the principal orders and careful indexing, it should be possible to order patterns by cable as easily as sizes are ordered under present methods of supply.

(*f*) *General.*—Large quantities of blocks from America and the Continent are imported into England in the finished state, and inquiries have been received in Western Australia from English importers wishing to buy jarrah blocks similarly manufactured. Great economies are possible if this trade can be established. Special care is necessary to supply the article required, as the shipping of inferior qualities or partly-seasoned material will raise a prejudice that may not be removed even by the supply of perfect material for many later years.

A parcel of machined blocks has recently been shipped to South Africa, and, although over-supplied to allow for some rejects, the average quality could not be said to approach that which could be produced from strips supplied to the English and Continental markets. The seasoning also was not uniform. Complaints are likely to arise regarding this parcel, and it is expected to give an unfavorable impression of the possibilities of jarrah for this use on the South African market.

Specification for machined blocks.

A tentative specification has been drafted to cover the same quality as that expected under the specification for sawn strips. Quality only is covered. This specification has not been considered as thoroughly as the specification for sawn strips, and is therefore more liable to be modified. It is given in Part IV.

3. Mine Lift Guides.

Trade in mine lift guides, also known as sliding beams, has developed considerable proportions in recent years. The principal countries to which they have been exported are South Africa, the United Kingdom, and Holland (to a port of entry for the Ruhr Valley coal mines). In Australia, karri has been used with very satisfactory results in the mine shafts in Broken Hill and on the eastern goldfields of Western Australia.

The development of the overseas trade has been largely assisted by the relative levels of Australian and American exchange rates. Jarrah and karri are now replacing pitch pine. Whether Western Australia can retain the market created under the present favorable circumstances will depend on the life of jarrah and karri compared with pitch pine and on the shippers' ability to maintain a uniform quality. Present results indicate a satisfactory life, so that the supply of a uniform product becomes of paramount importance.

It should be noted that the establishment of a satisfactory basis for supply will result in an extensive and regular demand. The lift guides in mine shafts have to be continually renewed. Even the best guides have a limited life—if jarrah and karri last three years they will be considered very satisfactory—and consequently the demand will recur every three years or so for refitting each shaft. This should result in a steady demand at all times for mine lift guides.

A point to be stressed is that a parcel of lift guides is only as good as the worst pieces in the parcel. A shaft, fitted with 200 lift guides might contain a dozen inferior guides. The life of the whole 200 will be limited to the life of the inferior dozen, because individual replacements are not desirable. It follows that suppliers should aim principally at uniformity. When an order is supplied from a number of different mills, the only means for ensuring uniformity is to adhere to clearly defined specifications.

Present specifications.—Typical specifications are given below:—

South Africa.—To be first class selected quality standard, free of all defects, straight, and out of winding, suitable for mine guides, to be cut full, and ends treated with petrolatum.

Continent.—To be first class selected quality timber, free of all defects and worm holes, also straight and out of winding, suitable for mine guides, to be cut full, and ends treated with petrolatum.

Field observations.—Both jarrah and karri mine guides were seen at various mills, and observations were made during the loading of a large number for South Africa at Bunbury. The custom of the trade was far from complying with the specification of "free from all defects." The quantity of material which could be supplied under this specification in sizes and lengths ordered would only represent a small proportion of the quantity actually supplied. Sawmillers rely on the portion of the specification which states that material must be "suitable for mine guides," but the interpretation of just what is suitable for mine guides varies considerably from mill to mill.

Mine guides are used flat against two sides of the shaft, and a grip attached to the cage overlaps the edges of the guide. The edges are the important wearing surfaces, while one face is exposed to wear in a minor degree. The essentials of a suitable mine guide are, therefore,

two good wearing edges, one good wearing face, straightness, and even size. Sawn material is dressed prior to use, so that evenness of size is important, as all have to be dressed to the size of the smallest. Too much oversize is obviously also a defect.

The aim of the present investigations has been to study defects included in present shipments in order to draft specifications which will form a reasonable basis for the supply of a uniform article. It is appreciated that a limiting specification based only on surface defects is not entirely satisfactory. The general quality, in so far as it affects wearing properties, is as equally important as small defects which may dress out or disappear after comparatively little wear.

On the other hand, surface defects can be limited according to size and frequency of occurrence, and it may be expected that pieces with the greater amounts of surface defects have a greater amount of concealed defects, and are, therefore, less generally suited for use. General quality cannot be defined in a specification, and such considerations must be left to the discretion of the sawmiller or inspector. In considering limiting defects in practice, the general quality of the piece is always taken into account.

(*a*) Jarrah Guides.

Conclusions with respect to jarrah are based on the examination of 345 pieces, mainly $8\frac{1}{4}$ x $4\frac{1}{4}$ x 30-32 feet produced at five different mills, and on a consideration of the class of karri being supplied for the same purpose.

Until a specification had been drafted, the guides were described individually. These were subsequently placed in quality groups by referring to the specification. Later, guides were placed in groups according to the specification, doubtful pieces only being described. A summary of the classification of all jarrah guides examined with reference to the measuring specification is given in Table 19. The defect limits are the same as those in specification 3a, jarrah mine lift guides, listed in Part IV.

TABLE 19.—QUALITY OF JARRAH MINE LIFT GUIDES.

Mill No.	Number of guides in quality groups.						Percentage Distribution.
	(1).	(2).	(3).	(4).	(5).	Total.	
Definitely above specification ..	94	15	17	45	37	208	60
Approaching limit	48	8	8	5	12	81	24
Below specification	14	7	17	7	11	56	16
Totals	156	30	42	57	60	345	100

It should be clearly understood that the recommended specification 3a does not cover the custom of the trade, and that it rejected 16 per cent. of the guides examined. The possibilities of modifying the specification to reduce the number of guides falling below it have been examined. A reconsideration of the defects in the rejected guides indicates that the limits would have to be increased greatly to admit an

appreciable number of guides. To admit nearly the whole 16 per cent., a specification approaching that for merchantable scantling would be necessary, but, as the quality of the whole is only equal to the quality of the worst, this is considered inadvisable. A consideration of the quality of mine guides supplied in karri (fully discussed later) indicates that 98 per cent. would pass an equivalent specification. Unless the quality of karri guides is to be lowered, it would seem inadvisable to attempt a lower standard specification for jarrah.

An alternative is to write two grades for jarrah—one for mills capable of supplying a quality equivalent to that of karri, and a second that would permit greater production, especially in poorer bush. A trial specification written below covers the greater number of the 56 guides rejected by specification 3a.

Trial Specification for Jarrah Mine Guides.—

To be sound timber, free of heart, unsound knots, shakes and splits, but allowing sap and the following defects to the extent indicated:—

On one face and either edge.—

1. *Gum veins.*—Tight gum veins, the total length not to exceed one-third length of piece.
2. *Gum pockets.*—Up to 6 x ⅜.
3. *Knots.*—Sound tight intergrown knots up to 2-in. diameter in any 5 lineal feet.
4. *Wane.*—Not to exceed ½ inch on face or ⅜ inch on edge.
5. Equivalent defect.

On other face.—

Defects in excess of the above may be allowed provided they do not hinder the perfect fitting of the guide in the shaft.

1. *Wane.*—Up to 1½ inch on the face and 1 inch on the edge, the total length not to exceed one-quarter the length of the piece.

Provided that the combination of defects at any section will not seriously impair the utility of the piece for a mine guide.

Compared with the specification 3a, the above is very lenient. Even a lax interpretation, however, would still reject 5 per cent. of the pieces examined. The custom of the trade is, however, approximately defined by this trial specification.

This specification has not been included in the list of recommendations because the supply of the limiting pieces admitted thereby cannot be endorsed. It is thought that the trade prospects are damaged by supplying the limiting pieces. No useful purpose is served by using this specification and stating that not more than 20 per cent. should fall below a higher limit, because, as already stressed, the life of the guides depends on the quality of the worst pieces installed in the shaft.

At one mill, it will be noted, the specification 3a rejected seventeen pieces out of 42 examined. The long length necessary for mine guides made production difficult with the class of timber available at this mill, and it was obvious that in an attempt to produce every possible piece the quality had been allowed to fall below that seen elsewhere. The rejection of a piece from use as a mine guide at the mills, however, does not mean an absolute loss, as it may be re-sawn to products of smaller dimensions. It is far more desirable to be rigid in inspection at the producing end than to risk a rejection after the expense of loading, transport, and delivery has been met.

(b) Karri Guides.

Karri mine guides were first seen at Bunbury in loading of a shipment for South Africa. Quality observations were made on 966 karri guides. As no detailed observations had been made previously on karri, the trial specification for jarrah was used as a guide in grading. As pieces were lowered in the slings and stacked in the hold, they turned so that the four faces of practically every piece were seen. The system adopted was to tally all pieces and to note defects as they occurred.

The general quality of the karri was so high that it was possible to note defects very much smaller than those allowed in specification 3a for jarrah. Pieces about which notes were made are, therefore, of very high quality.

Mine guides examined were from Mills Nos. 6 and 7. There is nothing in the observations to indicate any appreciable difference in the quality from these mills, and observations have been combined and shown in Table 20.

TABLE 20.—QUALITY OF KARRI MINE GUIDES.

—	No remarks.	Some defect noted but high grade.	Total high grade.	Approaching limit.	Reject.
Number ..	795	89	884	61	21
Per cent. ..	82·3	9·2	91·5	6·3	2·2

A comparison of this table with Table 19 indicates that the freedom from defects of karri guides is far greater than that of jarrah.

Detailed observations on mine guides at Mills Nos. 6 and 7 confirmed the general observations as to the relative freedom from defects of karri and jarrah guides. At the two mills, a total of 81 pieces were examined in detail. Mine guides are classified in Table 21 according to increasingly lenient specifications. The high general quality of the karri is at once apparent from a consideration of these data.

A specification based on classification 4 above would be very much more severe than the recommended specification for jarrah, and yet it admits 93 per cent. of karri seen at the mill. A more lenient specification (3b) has been written in Part IV. for karri intended to give a quality equivalent to that covered in the recommended jarrah specification.

If the two specifications are compared, it will be noted that the main differences in allowances are as follows:—

Sap and Wane.—No allowance for wane is made in karri unless treated, as it is considered that sap is more of a defect in karri.

Gum.—A shorter total length is allowed in karri, because generally gum veins in karri are wider than in jarrah.

Grub Holes and Grub Tracks.—These are very much more prevalent in karri than in jarrah, and thus need defining in karri.

TABLE 21.—CLASSIFICATION OF KARRI MINE GUIDES ON DETAILED OBSERVATION.

Class No.	Description of Class.	No. of pieces.
1	Guides clear on one face and two edges or better	12
2	Guides clear on two edges, one face showing small defects ..	9
3	Guides showing on one face or either edge defects not greater than—	
	(a) One grub hole ⅝″ diameter	33
	(b) A gum pocket 4 x ⅝	
	(c) Gum veins totalling 18 x ⅛	
4	Guides showing on one face or either edges defects not greater than—	
	(a) Four grub holes ⅜″ diameter	21
	(b) A gum pocket 4 x ⅜	
	(c) Gum veins total length 30″	
	(d) Grub tracks total length 12″	
	(e) Equivalent defect	
5	Other defects	6
	Total	81

Spring.—The same allowance is made for spring in each case. Bow, i.e., curvature of the face, is not considered to be a defect as the guide can be pulled into shape in the shaft. Spring—i.e., curvature edgewise—is, however, a serious defect in that a large amount cannot be removed in fitting the guide in the shaft. In the specification, spring is limited to 1 inch in 25 feet or equivalent. Avoidance of spring is partly a matter of skill in sawing, but where it occurs to a greater extent than allowed, it can be removed on skids by stacking on edge with straight guides piled on top for a period before shipment.

A considerable number of part quarter-cut pieces were seen which did not show excessive spring. Any restriction on the direction of cutting would have a serious effect on production, particularly in the karri, where a large proportion were cut either half back and half quarter, or part quarter, in addition to a small percentage cut on the full quarter.

General notes on recommended specifications.—It has already been stressed that the jarrah specification does not define the custom of the trade, and that it is rather severe on present production. On the other hand, the recommended karri specification is considered to be just a little below the present standard. The two, however, aim at giving a product of equal suitability.

The mechanical life of guides is comparatively short, and it is assumed that the relative durability of the two species will not be a factor affecting the relative suitability of karri. It is assumed also that there would be very little difference in mechanical life in jarrah or karri guides graded to an equivalent specification. Further, since the price of jarrah is slightly higher than the price of untreated karri, this does not justify a higher grade in karri. When graded to equivalent specifications, there is no reason apparent at the supply end for preference of either species for this particular product.

There is much to be said in favour of equivalent specifications for jarrah and karri setting one standard of mine guide only. The recommended specifications give our ideas of what these should be. They are based on a careful consideration of data available, but there are several factors on which we have very little information, and further data might result in a modification of recommendations. On information collected from the production end, however, we are in a position to gauge the effect on the present custom of the trade of any suggested modification.

Possible alternatives to recommendations are given as listed below—

(*a*) Equivalent specifications giving one standard of product, but to a different grade limit than that recommended.

(*b*) A specification to a different standard for each species with a price margin based on relative quality and ease of production.

(*c*) Two grade limits for each species with suitable price margins aiming at two equivalent standard grades. The higher grade might be almost entirely produced in karri with some production from those jarrah mills with the best bush.

Production to the lower grade limit would probably mainly be confined to jarrah. The alternative (*c*) would probably cover present practice better than that recommended, but immediately two grades are defined a reasonable price margin between the two has to be established to sell the lower grade, and it is doubtful if a sufficient price could be obtained for the lower grade to enable production.

4. Crossarms.

Introduction.—During the time available, no jarrah crossarms were seen. The study of this class of product is limited to karri crossarms produced at Mills Nos. 6 and 7.

Over the past two and a half years, the annual production of karri crossarms has averaged 90,000 cubic feet, approximately one-third being cut at Mill No. 6, and the balance at Mill No. 7. The relative importance of crossarms in the saw-mill production, excluding fruit cases, at the two mills is shown in Table 22 for half-yearly periods.

TABLE 22.—IMPORTANCE OF KARRI CROSSARMS IN MILL PRODUCTION.

Half-year ending—	Percentage of total sawmill production, excluding case stock.		
	Mill No. 6.	Mill No. 7.	Total.
	%	%	%
December, 1930	3½	18	7½
June, 1931	6	35	16½
December, 1931	12	58*	20½
June, 1932	4	41	15½
December, 1932	13	35	18½
Average	7	34	14½

* Low total production.

From the table, it is obvious that crossarms are an important major item of production at Mill No. 7, while at Mill No. 6 they form more of a by-product.

Monthly productions vary widely, especially at Mill No. 6, where for many months no crossarms were produced, whereas for one month the production rose to 48 per cent. of the mill output, and exceeded 20 per cent. for four months only. At Mill No. 7, the analysis of six separate monthly returns showed a range from 50 per cent. to 78 per cent..

The short length and comparatively small cross section of a crossarm permit production of a certain percentage from material that would otherwise be waste. Although a considerable variation in percentage output will be a normal feature in the production of such stock, the practice of ceasing to cut for some months and subsequently commencing to place 48 per cent. of the output into crossarms is undesirable. The month at Mill No. 6 showing a production consisting of 48 per cent. crossarms is followed immediately by months showing 2 per cent. and 3 per cent. respectively. Obviously this is due to the hurried cutting out of an order. With the greater portion being ordered for one user, the British Post Office, it should be possible to reserve an order sufficient at least to absorb all material which could be produced as a by-product.

In considering observations on arms from Mill No. 6 and Mill No. 7, Table 22 should be kept in mind, as the figures reveal conditions that probably affect the average quality of arms produced.

Present Specifications.—A typical quality specification is as follows:—

Must be selected quality timber docked die square and to exact length, also to be free from dead wood, sap, gum, shake, knots, &c., to be cut full with the usual crossarm allowance for shrinkage.

Quality Observations at Mills.

Mill No. 6.—Detailed quality observations were made on 1,000 arms. A parcel of 250 arms stored for eight months was also turned. The general quality appeared similar to those examined in detail. In arms exposed to circulation, a considerable amount of surface checking had taken place. Slight diamond was also noted on several pieces.

Rejects in loading from an estimated quantity of 4,000 arms were examined with the following results:—

		No.
Suitable		10
Reject for—	Diamond	62
	Undersize	62
	Splits, shakes, and excessive surface checks	50
	Excessive gum	10
	Miscellaneous	10
		204

Most of the rejects are thus for defects occurring in seasoning. The small percentage of rejects for inherent defects in this instance, and the absence of any great number of rejects in other loading, indicated that the general quality loaded could be taken as approximately the same as that on the skids, allowing for a few rejects obviously below the general standard. Results of detailed observations on the 1,000 pieces have therefore been accepted as fairly closely indicating the quality being shipped from this mill, and are as shown in Table 23.

TABLE 23.—QUALITY OBSERVATIONS ON 1,000 KARRI CROSSARMS AT MILL NO. 6.

—	Number.	
Clear		596
Small defects—		
Pinholes, up to 4	55	
Grub holes, small, 1 or 2	50	
Gum, up to 3″	86	
Gum, up to 6″	35	
Knots, small, intergrown, up to ¼″ diameter	41	
Knots, small, intergrown, ¼″ to ½″ diameter	8	
Sap	9	
Cross grain, slight	19	
Combination, small defects	29	
	—	332
Other defects—		
Pinholes	7	
Gum, exceeding 6″, or ⅛″ in width	28	
Cross grain, serious	10	
Shakes and splits	17	
Knots, over ½″ diameter	2	
Combination of defects, serious	8	
	—	72

From the table, it is clear that the quality of the arms does not correspond with the nominal specification. Only 60 per cent, are absolutely clear, small defects being found in 33 per cent.

Specification No. 4a has been drafted following consideration of observations at both mills. This specification would reject all arms shown in Table 23 as containing other defects. It is much more lenient than that under which the arms are supplied, and yet 7 per cent. of the production as seen at Mill No. 6 would still be rejected. Further rejections for severe surface checking would have to be made in loading. The specification drafted is a compromise between the custom of the trade as seen at the two mills. While rejecting a small percentage of arms as produced at Mill No. 6, the specification should allow increased production from the same logs at Mill No. 7.

Mill No. 7.—In the production of crossarms, this mill aims at eliminating all visible defects except that a certain amount of sap and seasoning checks are allowed. The quality is maintained at a very high standard, and the system of inspection is rigid. After leaving the docker, the crossarms are inspected by a special member of the yard crew who rejects arms that are considered not good enough. Further inspection is applied during loading.

Quality observations were made during the loading of over 7,000 crossarms. Results are shown in Table No. 24.

TABLE 24.—KARRI CROSSARMS AT MILL No. 7.

—	Number.		Per cent.
Clear		6,721	93
Definitely suitable but showing—			
Inherent defects—			
Sap	139		
Included sap	28		
Gum	25		
Grub holes	43		
Pin holes	30		
Knots	27		
Cross grain	21		
	313		
Seasoning or manufacturing defects—			
Seasoning checks	36		
End splits under 4″	49		
End splits 4″ to 6″	26		
	111		
		424	6
Pieces of doubtful suitability—			
Inherent defects—			
Gum	1		
Grub holes	2		
Knots	5		
Cross grain	21		
Shakes	1		
	30		
Seasoning or manufacturing defects—			
Checks	39		
Splits	5		
	44		
		74	1
Total		7,219	

The rejection during loading of 9,600 arms, amounting to approximately 2.7 per cent., were carefully examined and defects noted. A rough specification for crossarms drafted following observations at Mill No. 6 was applied to these observations with the result shown in Table 25.

This table indicates that the 2.7 per cent. rejects in loading is made up of approximately 1.1 per cent. considered quite suitable, but containing defects, 0.6 per cent. which should have been rejected for inherent defects, and 1.0 per cent. which should have been rejected for manufacturing or seasoning defects.

A first consideration of the table might indicate that a lowering of the specification would not have a very great effect on mill production in that only 1.1 per cent. out of a small total of 2.7 per cent. now being rejected in loading would be admitted. It will be noted,

however, that practically every piece showing defects for which some allowance is made (pinholes, grubholes, and gum) would be admitted. Most of the pieces showing these small defects are at the present time rejected during stacking. No definite figure could be obtained to show the percentage of pieces rejected in the yard after leaving the mill docker, but this was estimated by the yard crew to be about 10 per cent.

TABLE 25.—ALLOCATION OF REJECTS FROM TABLE 32.

—	Number.	Percentage of total loaded.
Accept showing—		
Inherent defects—		
Grub holes up to ¼″	20	
Pinholes	2	
Gum	12	
Small defects	7	
Combination	4	
	45	
Seasoning and manufacturing defects—		
Checks	55	
No apparent defect	5	
	105	1.1
Reject showing—		
Inherent defects—		
Sap	27	
Pinholes	1	
Grub holes	2	
Knots	2	
Gum	1	
Bark pocket	1	
Shakes	8	
Cross grain	9	
Combinations	9	
	60	0.6
Manufacturing and seasoning defects— ..		
Undersize	14	
Miscut	1	
Diamond	10	
End splits	23	
Seasoning checks	48	
	96	1.0

Observations at Mill No. 6 indicate better the effect of allowing these small defects. If the same standard of inspection were applied to this mill production as to Mill No. 7, it is estimated that at least 30 per cent. would be rejected. The rough specification drafted would have rejected 7 per cent., so that the increased production possible at Mill No. 6 by allowing these small defects can be set down at 23 per cent

It cannot be immediately assumed that a similar increase in production could be made at Mill No. 7 by admitting small defects, since at Mill No. 6 a great deal of clear material, which at Mill No. 7 would

go into crossarms, is cut into another high-grade product. It can be confidently claimed, however, that production at Mill No. 7 could be increased by at least 10 per cent. by allowing the small defects as suggested. As Mill No. 6 is supplying the same markets, the same standard should obviously be maintained.

While every effort is made at Mill No. 7 to avoid sending arms cut close to the heart, it is very probable that a percentage are sent. These, while apparently perfect, are not nearly as good as many arms showing small but visible defects. There is no way of defining general quality by specification, unless a mechanical test is called for. It is absurd, however, to reject on the very small visible defect when the strength may be affected to a far greater degree by the factor of general quality.

Some allowance can be made for sap, as this is apparently accepted if on one corner, but not if across the whole face to any appreciable depth. It should be recognized that a touch of sap is proof that the arm has been sawn from the soundest part of the tree, and for this reason a trace should be welcomed rather than considered a cause for rejection. When sap is allowed in karri, however, the effective section must be taken as that portion free of sap owing to the lower durability of the sapwood. Based on loading at Mill No. 7, a reasonable allowance for sap would be "sap on one corner to ½ x ½ or equivalent." Very little sap would be left on such an arm after dressing. It is considered that an arm showing a considerably greater allowance than suggested would be better than many apparently perfect arms cut approaching the heart.

Observations on seasoning defects.—The rejection in loading, due to seasoning defects, both at Mill Nos. 6 and 7 of such an appreciable quantity, points to the conclusion that some means of protecting the exposed arms from rapid initial drying is advisable. At Mill No. 7, and till recently at Mill No. 6, arms are block stacked on the skids with no protection of bottom or top layers. Ends are protected with petrolatum. At Mill No. 6, a system of stripping on skids has been recently adopted aiming at partial seasoning, but still no protection of bottom or top layers is attempted.

The relative importance of seasoning checks can be seen from Table 26 giving the number and percentage of pieces at Mill No. 7 showing checks and splits.

TABLE 26.—EXTENT OF SURFACE CHECKING IN 9,600 CROSSARMS AT MILL NO. 7.

—	Number.	Per cent.
Pieces loaded—		
Suitable ..	111	1·5
Doubtful suitability	44	0·6
Pieces rejected—		
Probably suitable ..	55	0·6
Reject ..	75	0·8
Total	280	3·5

Owing to the difficulty in measuring checks, the only clause applied to determine suitability was "free from serious checking." Interpretation of this was largely affected by the extent of checking in the particular shipment under inspection. A large allowance would have been necessary to admit the same number of pieces. The table indicates that doubt existed as to the suitability of 99 pieces out of the 280 on the general clause. This is admittedly not very satisfactory, but no better clause can yet be suggested.

The use of face cuts at the bottom and top of stacks as a protection from excessive circulation would, at a very small increase in stacking costs, considerably reduce the number of seriously checked pieces. Owing to the generally interlocked nature of karri, a small amount of surface checking is no great defect, but when developed as badly as in some pieces now shipped, the checks would undoubtedly have a far greater effect on the mechanical strength of the arm than small defects present in many pieces now rejected.

Size.—In the case of arms to be used by the British Post Office, different sawing sizes are adopted at Mills Nos. 6 and 7 for arms that will evidently be the same size when finally erected. This is due to the fact that the supply to the Post Office is through the agency of intermediate contractors who carry out the necessary seasoning and machining. The nominal sizes supplied from Mill No. 6 are $2\frac{5}{8}$ in. and $3\frac{1}{8}$ in., while from Mill No. 7 they are $\frac{1}{8}$ in. less.

At Mill No. 6, in cutting full to allow for seasoning, the sizes shown on the books are $2\frac{3}{4}$ x $2\frac{3}{4}$ and $3\frac{1}{4}$ x $2\frac{3}{4}$. Measurements on 200 pieces indicate an average cutting size of $3\frac{3}{8}$ x $2\frac{7}{8}$ with few pieces below $3\frac{1}{4}$ x $2\frac{3}{4}$. It is interesting to note that actual cutting is 18 per cent. above nominal size.

At Mill No. 7, the cutting size shown on the books was 2 11-16 x 2 11-16, and pieces were rejected if noted under $2\frac{5}{8}$. Measurements were made on 122 pieces of the smaller-sized arms, and these showed an average size of $2\frac{3}{4}$. None of the arms was below $2\frac{5}{8}$, but if the average size had been that shown on the cutting books and the same variation in sizes were found, 6 per cent. would have been undersize.

The $\frac{1}{8}$-in. difference in nominal size at the two mills is thus also shown in the cutting size. The practice at the two mills can be fairly closely defined by stating that average cutting is $\frac{1}{4}$ in. above the nominal size, and that the minimum size is $\frac{1}{8}$ in. above the nominal size.

Assuming that arms will dress to the same size, it should be possible to establish one cutting size for all mills. This would simplify production for stock. It is thought that the finished size of arms, nominally $2\frac{1}{2}$ x $2\frac{1}{2}$ from one mill and $2\frac{5}{8}$ x $2\frac{5}{8}$ from the other, is $2\frac{1}{4}$ x $2\frac{1}{4}$. A minimum size of $2\frac{5}{8}$ should be sufficient to allow for shrinkage and machining. Ordering to the larger green size is advantageous in that the percentage of rejects through undersize and diamond after seasoning should be less. By cutting to a minimum size of $2\frac{5}{8}$ on a nominal size of $2\frac{1}{2}$, and machining to $2\frac{1}{4}$, the rejects after seasoning should be well below 10 per cent., which is the oversize paid for in ordering $2\frac{5}{8}$ nominal size.

Direction of cutting and its effect on diamond.—In all timbers, shrinkage is very much greater in a tangential direction with respect to the growth rings than in a radial direction. With jarrah and karri, the shrinkage in the tangential direction is approximately 50 per cent. greater than in the radial direction. It follows that if any piece of square or nearly square section is cut with the growth rings along the diagonal, the piece will shrink in seasoning to the form of a diamond.

In a specification to cover wooden crossarms issued by the Australian Postmaster-General's Department (Specification 533B, issued 18.5.32) a clause has been inserted to overcome this difficulty by providing that—

"In timber subject to collapse or shrinkage, the crossarm shall be cut so that the growth rings extend from one face to the parallel face in such a manner that the angle of inclination of the growth rings to such parallel faces shall be not less than 70°."

While this clause would eliminate practically all arms in which diamond is likely to occur, it has been drafted with the ash group of eucalypts of the eastern States in mind. These suffer severely from collapse, and arms cut with the growth rings showing diagonally on a cross section are likely to diamond very severely. Karri is not appreciably affected by collapse, so that while slight diamonding from normal shrinkage does occur, it is not such a serious fault. Counts were made at both mills on nearly 1,400 crossarms to show the direction of cutting under present practice. Results are given in Table 27.

TABLE 27.—THE DIRECTION OF CUTTING OF KARRI CROSSARMS.

Description of Cut.	Angle.*	Per cent.
Full back or full quarter	75° to 90°	16
Part back or part quarter	60° to 75°	38
Half and half	45° to 60°	46

* Approximate angle of inclination of growth rings to parallel faces.

The diamonding clause in the specification would reject all the arms shown as "half and half" in the above table, plus a proportion of those shown as "part back and part quarter" in which the angle of the growth rings runs from 60° to 75°. The count shows that if the angle of inclination had to exceed 70°, well over half of the arms at present produced would have to be rejected.

The same conclusion can be reached from a general consideration of the method of production of arms. In breaking down jarrah and karri logs, every cut is either at right angles to or parallel to the first cut made in the log. It follows that only a small proportion of the whole log can be cut on the full quarter or full back. Assuming that the whole log was being cut into crossarms, the horizontal and vertical

lines in Diagram 3 shows the sawcuts which would be made in one-quarter section of the log. The radial lines indicate the division of the arms into those cut on the full back or quarter, those part back or quarter, and those half and half. The number of crossarms cut in each direction will be in an exact ratio of the area of the sector, i.e., one-third will be on the full back or quarter, one-third on the part back or quarter, and one-third half and half. If now the production of crossarms is limited to those in which the angle of inclination of the growth rings is greater than 70°, it would mean as shown in Diagram 4 that no production of crossarms could be attempted from the greater

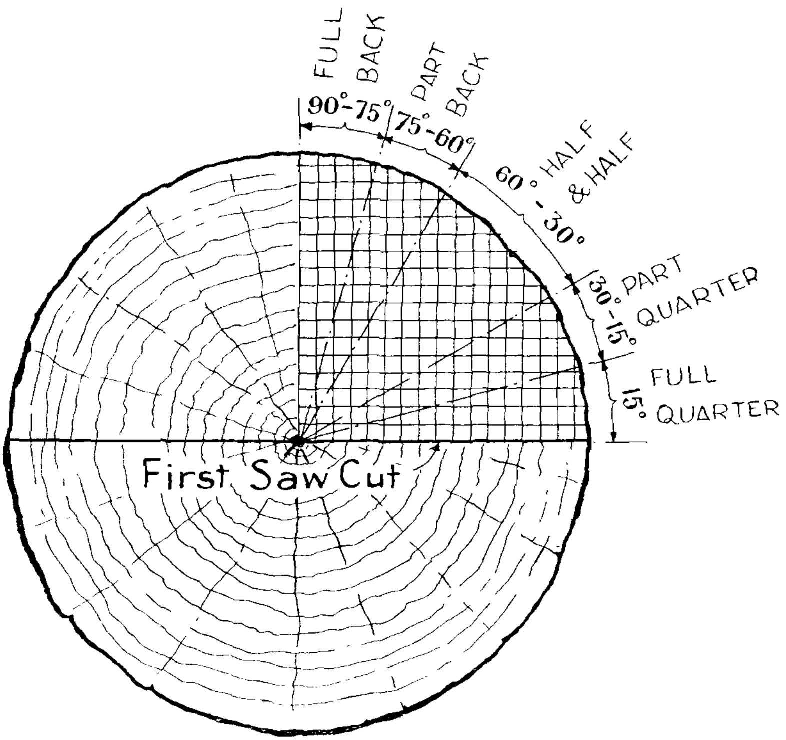

Diagram No. 3. Direction of growth rings in Crossarms.

part of the log, since only that portion shown cross-hatched gives arms with the direction of cutting as specified. The cross-hatched portion is only 44 per cent. of the entire log. If the whole log were sawn into crossarms on present methods of production, 56 per cent. would have to be rejected by this clause. Actually, the small size of crossarms makes their production possible from wing pieces (which is very desirable in the saw-mills to increase the recovery), and the percentage

which would be rejected because of this practice would be even higher than if the whole log were converted into crossarms. It is generally recognized that altering the method of breaking down to produce a greater percentage of full back or quarter material would reduce the percentage recovery. Crossarms being only one product, this is entirely out of the question. The above discussion indicates that, in the case of karri, the diamonding clause is unsatisfactory.

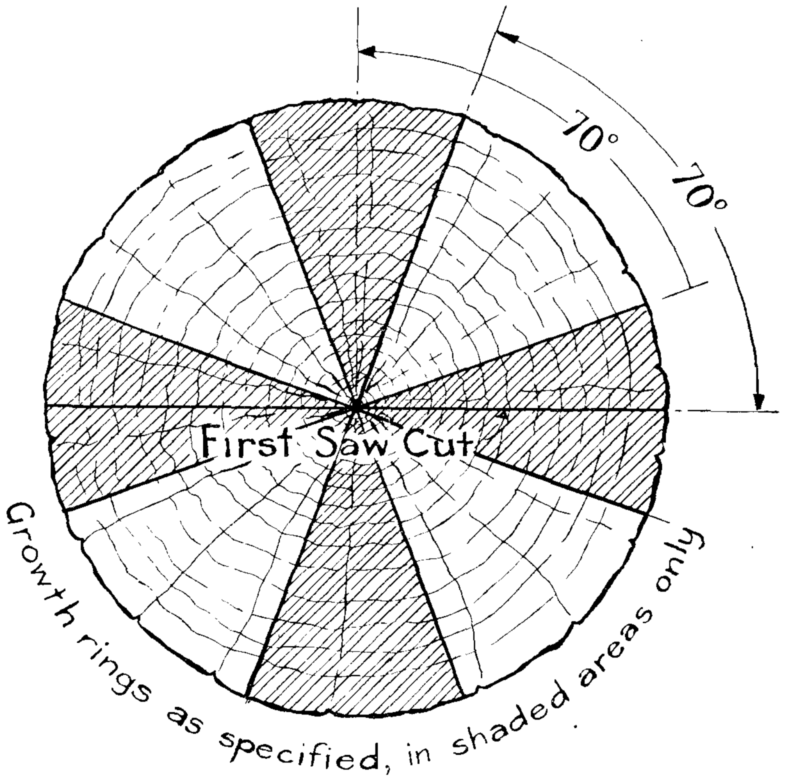

DIAGRAM No. 4. Proportion of log which could be cut into Crossarms with slope of rings on cross section 70° to 90°.

Specification No. 4a has been drafted to cover supply of material almost straight off the saw. It is difficult to specify the amount of diamond that might be allowed in parcels held for a period before shipment. Any allowance would probably be inadequate for properly seasoned arms, and quite useless in arms a few months off the saw, as these would develop further diamond with normal shrinkage. No stated allowance has therefore been given. In buying material green, the buyer should be prepared to lose a very small percentage through abnormal shrinkage and diamond which cannot be covered by reasonable allowances in sawing. Similarly, no stated allowance for undersize would be satisfactory in that portion of a shipment exposed to circulation while held on the skids.

Discussion of specification issued by the Commonwealth Postmaster-General's Department.—

This specification 533B, issued 18th May, 1932, has already been referred to, and a copy is given in Appendix No. 1 (*g*). It is evident that a good deal of thought has been spent on this specification in an endeavour to allow small defects that do not affect the suitability of the piece for the purpose intended. The application of the specification has been considered in the light of observations at Mills Nos. 6 and 7. The discussion below indicates some of the difficulties attendant upon its application to karri. Clauses are discussed in their order of appearance in the specification.

2.—(1) Timber to be unaffected by grubs or borers. This would reject 5 per cent. of arms at Mill No. 6.

(2) Gum veins not to exceed 1-16 inch in width. This would eliminate practically all gum veins in karri, as they are usually wider than 1-16 inch even if short. Limiting width to ⅛ inch and total length to 6 inches would reject 2.8 per cent. at Mill No. 6. A limitation to 6 inches in individual lengths would admit at least half the 2.8 per cent. rejected as above 6 inches. The Postmaster-General's specification admits gum in individual lengths to 18 x 1-16, and total length 36 inches on any face, which should be worse than gum to the extent of 6 x ⅛ in individual lengths and a total length of 12 inches as suggested.

(3) Knots are not common in karri, and if clear of the centre foot and limited to ½-in. diameter they should be no defect.

(4) Arms have been seen definitely showing diagonal grain to the extent of 1 in 15, and localized cross grain to a greater extent, and have been considered satisfactory. A limit of even 1 in 20 would reject most of the nineteen pieces shown as with slight cross grain in addition to the ten pieces showing serious cross grain. Actually, in practice, it is extremely difficult to measure cross grain unless one face of the piece of timber is cut on the full quarter. On the back or half-back, an annual ring just cutting out will give the appearance of cross grain. The clause, free from serious cross grain, is favoured, because owing to time limitations it was not possible actually to measure and list the extent of this defect. It is realized that ultimately the severity of cross grain permissible should be defined by a maximum allowable slope, but this cannot be done at present, because there are no data to indicate the effect of any limit on present production.

(5) The limitation of surface checks to 4 inches and of no appreciable depth would reject any arms in karri which had been at all exposed to circulation. No satisfactory basis has yet been determined for limiting checking in karri. The interlocked grain makes cleavage radially very difficult in spite of bad surface checking, so that some allowance should be made. The only suggestion that can be made at the moment is "free from severe surface checking." This is admittedly not satisfactory, because in most instances, when the seasoning of karri is attempted, surface checking will probably occur in a large percentage of the pieces.

5. Miscellaneous Products.

(a) Wood Pipe.

All wood pipe stock is produced for a wood pipe company which operates factories in Sydney and Melbourne. Prior to 1932, the material thus formed an interstate export. Late in 1932, a proposal to erect a factory in Perth was put into effect, and it is intended to commence manufacturing at an early date. The operation of this factory will add to the importance of the trade in wood pipe stock, as the product will then be consumed locally and also exported. The trade will still be confined, however, between one supplier and one consumer, so that the grading of the timber is a matter for satisfactory understanding between these parties rather than a problem in general marketing. Nevertheless, it is in the interests of timber utilization to assist in arriving at the best basis for supply.

The quality requirements in wood pipe stock are exacting, faultless timber being required. Preliminary investigations concerning the sawmillers' ability to supply were carried out at one mill on approximately 150 cubic feet of sawn material. A lead is thereby given if further work is called for in preparing suitable complete specifications.

Karri is the only Australian timber now used in the manufacture of wood pipe. It is at present produced in sizes nominally 3 x 1, 4 x 1, and 5 x 1¼, the last being intended for use locally in renewing the Goldfields Water Supply pipe line, and others being exported to the Eastern States. Pieces are produced in double thickness, fluarised, and are re-sawn on a mill saw-bench. Each final piece has then an untreated surface which, in the finished pipe, becomes the surface in contact with the water.

Field observations on quality.—The quality ordered is "prime selected karri, free from all defects, suitable for manufacture of wood pipe."

The product absorbs the best parts of the log, and special care is taken to eliminate visible defects. Under present methods of production, two main inspections are necessary—firstly, by the mill dockerman; and, secondly, by the tailer-out at the re-saw bench. It is inevitable that part of the material produced by the sawmill needs some docking after fluarising and re-sawing, because some defects in the centre of the double piece do not show until after re-sawing. The inspection prior to loading should ensure the elimination of unsatisfactory pieces.

Results of quality observations on 150 pieces of double thickness straight off the saw are shown in Table 28.

The total recovery at the mill from the double piece in those needing docking should probably be 65 per cent. The percentage loss would then be 12 per cent.

A second series of observations was made on material that had passed the next stage in manufacture, namely, fluarising and re-sawing. A detailed examination of pieces set aside for docking during the re-sawing of approximately 1,000 pieces showed that 3 per cent. loss occurs at the re-saw mill. This figure is based on a minimum usable length of 8 feet.

TABLE 28.—OBSERVATIONS ON WOOD PIPE STRAIGHT OFF THE SAW.

—	Per cent.	
Suitable without docking—		
Clear	35	
Clear, but showing sap	8	
Tight intergrown knots, ¼″ diameter	9	
Very small defects, probably suitable	13	
	—	65
Percentage needing docking after fluarising for—		
Grub holes	15	
Pin holes	6	
Gum, up to 3 x ⅛	6	
Gum, exceeding 3″	4	
Miscellaneous	4	
	—	35

A further quantity of material that had been split and passed for loading was examined in detail. Sixty-five per cent. of this material was perfectly clear; 15 per cent. clean in the double thickness had opened up showing defects (comprising 10 per cent. small defects and 5 per cent. large defects); 4 per cent. had developed checks in seasoning, although this fault is probably not deleterious; 6 per cent. originally showing small defects showed large defects on opening up; and 9 per cent. had serious defects visible before fluarising. Thus approximately 20 per cent. of the material passed contained defects which would need docking out. Assuming that half this material would be recovered in docking, it is evident that 10 per cent. would be lost by the consumer in faulty material that could have been eliminated at the mill by more rigid inspection.

Combining observations on rejects at the mill and on material passed for loading, it is evident that the loss through necessary docking after fluarising is approximately 13 per cent. At present, 3 per cent. of this loss is borne by the sawmill and 10 per cent. by the pipe company.

Discussion.—The wood pipe company has stated that under present conditions of supply 9 per cent. of the lineal footage received is lost in conversion to finished pipe. This percentage is dependent to some extent on the ability of the factory to use a limited quantity of short lengths. It is doubtful whether the company would be prepared to accept any pieces as short as the minimum usable length. They favour the policy of keeping the lengths as long as possible, and rely on the docking out of defects that have been missed by the inspector to furnish all the shorts that can be absorbed.

The estimated loss due to defects in the parcel examined shows a fairly close agreement with the percentage loss now occurring in manufacture. More rigid inspection before loading could possibly reduce the percentage still further, but at least 5 per cent. unavoidable loss would result through the occurrence of defects which do not show up till after machining or through degrade in seasoning.

That some defective pieces are fluarised does not necessarily indicate faulty practice. Once a piece was reduced to wood pipe size, it was suited, at the time these observations were undertaken, to no other purpose, and consequently if the piece contained a small defect it went to the fire chute. In producing wood pipe in double thickness some pieces may show defects on one side and yet be capable of yielding one clear piece. As long as the cost of fluarising is less than half the cost of production, it would pay to fluarise the whole and subsequently discard one-half or dock it, rather than dock the double thickness and discard before fluarising. It is faulty practice, however, to forward pieces which, after re-sawing, need docking for defects which would not be admitted in the finished pipe.

A quality specification covering supply of the re-sawn product could only be "free from all defects." It is not known whether sap is a defect, but, judging by its ready absorption of preservatives, it is porous. Special care should be taken to recognize as defects patches of grey-coloured wood (thought to be included sap) which are frequently, but not invariably, associated with pinholes. This wood is definitely porous and must be eliminated in manufacture.

Field observations on size.—A general discussion of allowable variations in size is given elsewhere in this report. It is not intended, therefore, to repeat the statements in this section, but reference is made to size because of its special importance in chemically treated timber that is subsequently machined.

The need for improving present practice is indicated by the results of measuring 36 pieces, nominally 5⅜ inches x 3 inches. These showed variations of 0.70 inch (11-16 inch) in width and 0.38 inch (⅜ inch) in thickness. Further measurements on 42 pieces, nominally 4 x 1, showed variations of 0.34 inch (11-32 inch) in width and 0.18 inch (3-16 inch) in thickness. These do not show good practice.

The performance of the re-saw was also investigated by measuring 50 pairs. The difference in thickness between the halves varied from zero to 0.22 inch, and was less than 1-16 inch in 64 per cent. of the halves, greater than 1-16 inch but less than ⅛ inch in 26 per cent., greater than ⅛ inch but less than 3-16 inch in 10 per cent., and 7-32 inch in 2 per cent. Ten per cent. of the resulting pieces were 1.04 inch or less in thickness; and 12 per cent., 1.18 inch or greater. The variation in re-sawing must be recognized in computing a satisfactory green cutting size, in addition to the saw kerf or 0.16 inch. To allow for this, the minimum thickness of the double flitch is recommended to be 5-16 inch full just before re-sawing.

(*b*) Paving Blocks.

Quality observations on jarrah paving blocks were made at two mills, Nos. 3 and 4, at each of which 1,000 blocks were carefully examined. The material had been cut some time, and comprised surplus stock after despatch of export orders. In storage for very long periods, such stock deteriorates on account of exposure to the weather, and the outer blocks, particularly, develop checks and alter in size. Inherent defects only were, therefore, considered, so that the quality as measured would be the quality as it would appear immediately after

Results of investigations are shown in Table 29.

TABLE 29.—OBSERVATIONS ON PAVING BLOCKS AT MILLS NOS. 3 AND 4.

Type of Defect.	Number of Pieces.		Average per cent.
	Mill No. 3.	Mill No. 4.	
Free from all defects	724	702	71·3
Gum—			
Total visible up to 2″	51	44	
„ over 2″–4″	64	57	
„ over 4″–6″	55	73	
„ up to 6″	170	174	17·2
„ over 6″–10″	41	40	
„ over 10″	17	51	
„ over 6″	58	91	7·5
Pinholes—			
Under 4 per block	39	8	2·4
Over 4 per block	3	6	0·4
Grub holes	4	4	0·4
Miscellaneous—			
Knots, sap, bark pockets, &c.	2	15	0·8
	1,000	1,000	100

The above figures reveal that the custom of these mills in supplying paving blocks is remarkably similar. The effect of various limitations of defects on the mill production can be determined from the above data.

Present specifications.—A typical specification under which blocks are supplied at the present time is shown by extracts given in Appendix 1 (*h*) from a contract for supply of blocks to the city of Melbourne.

Appendix 2 (*d*) contains a draft specification for hardwood paving blocks issued for comment by the Standards Association in 1931. This was strongly objected to by the Western Australian Sawmillers Committee on Grading, mainly because no allowance for gum was made, and because sawing tolerances were considered to be excessive.

Suggested specification.—This is given in full in Part IV., and discussed below.

Gum.—It will be noted from the table summarizing observations that gum is by far the most important defect for which allowance has to be made, 25 per cent. of the blocks showing this defect. Limiting total visible gum to 6 inches would reject 7.5 per cent. of those examined. It should be remembered, however, that a good number of these would probably have been rejected during loading for despatch as containing excessive gum. With the limitation to 6 inches, it is difficult to imagine how the gum would be distributed to give a serious defect unless it occurred on the corner. To increase the allowance, additional clauses would have to be included stating how the gum might be distributed. An increased allowance would probably admit as many defective blocks as suitable ones.

Pinholes.—Two and a half *per cent.* of blocks examined showed pinholes not exceeding four per block, and 0.4 per cent. showing pinholes exceeding this number. A limitation has been placed on pinholes of a total number of four holes visible on all faces.

Other defects.—The total percentage showing other defects is only 1.2 per cent. Any satisfactory block showing other small defects such as a small knot or small grub hole would be admitted under the equivalent defect clause.

Tolerance in size.—As no blocks were being cut during the period of the investigation, no observations could be carried out on this point. At Mill No. 3 it was stated that the tolerances on present practice were $\frac{1}{8}$ inch in length, 1-16 inch in width, and 1-16 inch in depth. The tolerances suggested in Standards Association specifications are:—

	+	—
Length	$\frac{1}{4}$ inch ..	$\frac{1}{4}$ inch
Width	$\frac{1}{4}$ inch ..	1-16 inch
Depth	1-16 inch ..	1-16 inch

Tolerance based on ordinary scantling production would be:—

Length	5-16 inch ..	—
Width	3-16 inch ..	—

Length is the least important dimension, and the tolerance could be fairly wide. Varying widths, however, affect the perfect laying of the blocks. As cutting to depth is always done on special saws, a small tolerance is all that is required.

The following tolerances are suggested:—

	+	—
Length	$\frac{1}{4}$ inch ..	$\frac{1}{8}$ inch
Width	$\frac{1}{8}$ inch ..	1-16 inch
Depth	1-32 inch ..	1-32 inch

It will be noted that an allowance below nominal size is suggested. Although this is considered desirable, it may be the custom of the trade to supply all blocks over the nominal size. If such is required, it would be necessary to show the same range in tolerances, but with the nominal size as the minimum size. The range in width as suggested may seem excessive, but if it is desired to tighten up on this figure, it practically postulates machining to width after ordinary manufacture.

(*c*) Wagon Scantling.

As shown in Diagram No. 2, wagon scantling is an important item on the export market. Unfortunately, during the period of investigations covered by this report, no orders for wagon scantling were being cut at mills visited, except long lengths about $9\frac{1}{2}$ x $3\frac{1}{4}$ x 33 feet long. A considerable amount of detailed data on this particular size was obtained, but this is held for the time being, as it is proposed to carry out an investigation on the production of wagon scantling generally as soon as a suitable opportunity presents itself.

(*d*) Joinery.

As shown in Diagram No. 2, seasoned products other than flooring represent approximately 10 *per cent.* of local consumption. Timber for joinery purposes constitutes a large proportion of this. The immediate preparation of specifications to cover timber for joinery, although desirable, was not considered as important as fuller consideration of other classes of product, and no specifications have been attempted. No great

amount of timber for joinery changes hands except in comparatively small parcels, the greater part of it being made up into the final product in the metropolitan joinery shops of the larger sawmillers.

(e) Wheelwright Scantling.

It is thought that the grade limit for "specially select karri scantling" should cover supply of wheelwright scantling. The present specification is as follows:—

"Wheelwright Karri for Bending—Sawn untreated bending karri to be first class selected quality, green, straight off the saw, and on full back as required for bending."

Observations were made on a parcel of 103 pieces of 6 x 3 scantling 14 and 15 feet long. The direction of cutting was not noted, so that it cannot be said whether material is supplied on the full back as called for in the specification.

Applying the specification for specially select karri to observations would reject 17 pieces out of the 103, including 5 pieces which were definitely unsatisfactory for the purpose.

Pieces were rejected for the following reasons:—

Wane	2
Excessive gum	2
One or more grub holes up to $\frac{3}{8}$ inch ..	6
Cross grain	2
Definitely unsuitable	5
	17

The pieces showing gum and grub holes are just on the border line. A quarter of an inch is considered to be the limiting grub hole which could be admitted for this purpose. Some allowance is necessary, as 40 pieces examined out of the total of 103 showed either grub holes or grub tracks (holes on the surface just cutting out).

The number of pieces shown as clear (including 5 pieces with $\frac{1}{4}$-in. knots) was 41 out of the total.

Size.—Measurements on 82 pieces showed an average cutting size of $6\frac{3}{8}$ x 3 3-16, with a minimum size of $6\frac{1}{4}$ x $3\frac{1}{8}$, indicating that this class of material is cut full compared with the nominal size.

(f) Timber for Re-sawing.

The general opinion is held that jarrah is definitely not suited for re-sawing, and no grades have been written to cover the supply of timber for this purpose. Some consignment stock is forwarded to London in large sizes which may be re-sawn, but the practice is not favoured. Present specifications for the South African railways and harbours state that timber shall be suitable for re-sawing, but it is thought that in this case very little re-sawing is actually done. A letter of inquiry has been forwarded to South Africa in this connexion, but no reply is yet to hand.

Considerable volume loss is unavoidable in re-sawing from large flitches, and in addition the buyer has to pay higher prices for larger dimensions than for smaller section material direct from the mills. However, there may be considerations which render it advantageous for the buyer to re-saw in some cases, and further information on this is being sought.

III.—DISCUSSION ON SAWING SIZES.

The size of many products is equally as important as their quality. Variations in size occur in practice, some attributable to variations in sawing and some to the lack of uniformity in cutting instructions. Under present conditions, the different mills make varying allowances above the ordered sizes, which are usually purely nominal, for the particular class of product. Consequently, when an order is distributed among several mills, the products sometimes show an undesirable variation in size from piece to piece in the parcel. It is important that as much uniformity as possible should prevail throughout a shipment of any product.

The field work undertaken with a view to studying existing variations was designed, firstly, to determine what is a reasonable variation in sawing under present trade practice, and, secondly, to examine the relation of nominal size to actual cutting size aimed at.

1. Variations in Sawing.

The investigations of variations in sawing comprised the measuring of pieces straight off the saw. As already stressed in Part II., reasonable size specifications can only be written either for material straight off the saw or for fully seasoned material. Where sufficient measurements were made at one time, the percentages falling within various size ranges have been listed and shown in Table 31. Many other observations on size have been made, but the number in each set of measurements does not justify showing them in the same way on a percentage basis.

To show how these percentages were computed, results of width measurements on 200 pieces of block flooring, nominally 3 x 1, are given in Table 30.

TABLE 30.—MEASUREMENTS ON 200 PIECES 3-IN. x 1-IN. PARQUETRY FLOORING.

Width.	Number of Pieces.					
3·08 ..	3					
3·10 ..	5					
3·12 ..	5					
3·14 ..	3					
3·16 ..	5					
3·18 ..	13					
3·20 ..	20			90 % total variation $^3/_{16}$"	95 % total variation $^1/_4$"	100 % total variation $^5/_{16}$"
3·22 ..	24	73 % total variation $^3/_{32}$"	80 % total variation $^1/_8$"			
3·24 ..	32					
3·26 ..	19					
3·28 ..	28					
3·30 ..	23					
3·32 ..	12					
3·34 ..	1					
3·36 ..	2					
3·38 ..	3					
3·40 ..	2					

(Brackets in the original: 73 % = 3·20–3·30; 80 % = 3·18–3·30; 90 % = 3·14–3·32; 95 % = 3·10–3·34; 100 % = 3·08–3·40.)

The particular figures covering these observations are indicated in Table 31.

TABLE 31.—VARIATIONS IN SAWING OF DIFFERENT SIZES AT SEVERAL MILLS.

Product.	Approximate Nominal Size.	No. of Measurements.	Percentage Falling within a Total Variation of— 3/32".	1/8".	3/16".	1/4".	5/16".	3/8".	7/16".	1/2".
	Inches.									
4 x 4 flooring ..	1	100	91	95	100	..	..	..	..	..
3 x 1 parquetry ..	1	62	87	94	97	100	..	..	..	..
3 x 1 parquetry ..	1	191	96	99	100	..	..	..	..	..
3 x 1 parquetry ..	1	200	97	98	100	..	..	..	..	..
3 x 1 parquetry ..	3	57	96	98	100	..	..	..	..	..
3 x 1 parquetry (see Table 30) ..	3	200	73	80	90	95	100	..	..	..
3 x 1 parquetry ..	3	200	92	96	100	..	..	..	..	..
3 scantling ..	3	121	61	72	85	95	98	100	..	..
6 x 3" scantling ..	3	82	88	92	98	100	..	..	..	..
Crossarms ..	3	246	89	93	98	99	100	..	..	..
Crossarms ..	3	184	63	70	82	89	96	98	100	..
Crossarms ..	3	244	91	94	98	100	..	..	..	..
Mine guides ..	4	123	55	63	82	91	97	99	100	..
Mine guides ..	4	72	76	82	92	96	100	..	..	..
Mine guides ..	4	51	59	65	82	90	98	100	..	..
6 x 3 scantling ..	6	82	67	70	81	85	92	95	97	100
Mixed scantling ..	6	94	81	84	91	94	97	100	..	..
Mixed scantling ..	9	94	67	72	86	93	100	..	..	..

A close study of Table 31 will show that from various mills there is a considerable difference in the percentages within given size ranges for the same dimension product. For instance, in the inch thickness of flooring, it will be noted that on two sets of observations 96 and 97 per cent. of the pieces fall within a total size range of 3-32 inch, while on the other two sets of observations an allowance of $\frac{1}{8}$ inch only admits 95 and 94 per cent. respectively.

Considering 3-in. flooring widths, we find that at two mills a total allowance of $\frac{1}{8}$ inch would admit 98 and 96 per cent., whereas at a third mill an allowance of $\frac{1}{4}$ inch must be made to admit 95 per cent. In the case of crossarms, we find that at two mills a total variation of 3-16 inch admits 98 per cent., but in a third mill 5-16 inch total variation is necessary to admit 96 per cent.

Time available did not allow a detailed investigation into the effect of the different factors causing variation in sawing. A considerable variation is unavoidable. For example, a considerable variation in size must be expected when the big bench is used to cut a plank 18 inches wide for crossarms, and this is turned on to a rip bench for cutting to the other dimension. The same, of course, applies to other classes of product where one dimension is cut on one bench and the other on a second. The condition of gauge block and pins has a very great effect on accuracy in sawing. Many pins and gauges seen were in poor condition, making accurate sawing impossible.

It is obvious that too great attention to accuracy in sawing will considerably slow up production; on the other hand, when speed alone is aimed at in production, accuracy in sawing may be entirely sacrificed. In addition to all these variable factors, the skill of the individual sawyer has to be taken into account.

From consideration of the results shown in Table 31 and other data available, the following figures are suggested as showing reasonable allowable variations in sawing. It should be pointed out, however, that milling within such allowances would represent a considerable improvement on present general practice. That some mills are cutting within these allowances would indicate that attention to equipment and greater care in sawing would enable other mills to do likewise.

(1) *Ordinary Building and Construction Timber.*—For lengths up to 20 feet, total variation in material up to 4 inches—¼ inch, 5 inches to 8 inches—5-16 inch, 9 inches to 12 inches—7-16 inch, and over 12 inches—9-16 inch.

Longer lengths would allow greater variation.

(2) *Wagon scantling* in short lengths would allow smaller variations.

(3) *Boards*, nominal width 3 inches and 4 inches—total variation 3-16 inch.

Boards, nominal width 5 inches and 6 inches—total variation ¼ inch.

Boards, thickness 1 inch or thereabouts—total variation ⅛ inch.

(4) *Mine guides*, 8¼ x 4¼. Total variation ⅜ inch in width and ¼ inch in thickness.

(5) *Crossarms.* Total variation 3-16 inch.

2. Relation of Nominal to Cutting Size.

Following the above discussion of reasonable variations in sawing, attention can now be paid to the relation of nominal sizes to sizes aimed at in cutting, so that definite size specifications can be suggested for the various classes of product. Nominal size can either be related to average green size or to minimum green size. If the relationship between nominal and average sizes can be shown, then allowances above and below the average can be made to cover the variation in sawing already determined.

In American practice it is customary to sell all timber on the green size, as shown by the following extract from page 6 of the N. list covering export of Douglas Fir, &c.:—

> 22. All dimensions are sold subject to any natural shrinkage, whether "green," partially or wholly seasoned. It shall be the intention to manufacture all rough timber full size when green, but occasional variations in sawing will be allowed.

In Western Australia, the practice has grown up to make allowances in size according to the type of product, and nominal size is thus always well below the actual size cut.

The latter system has several serious disadvantages. The main disadvantage is that the percentage overcutting is not constant, varying from 7 to 10 per cent. in the case of sleepers to over 20 per cent. in

crossarms, and even as high as 30 per cent. or more in wood block flooring. The system gives entirely erroneous recovery figures, and tends to falsify ideas about relative prices.

Taking the system as we find it, however, the problem is to determine the allowances in average cutting above nominal sizes on present trade practice.

Measurements on mine guides give an example of the variations which exist from mill to mill in the allowances made in average cutting sizes compared with the nominal size. Table 31 shows the variation from the average at each of several mills, but does not tell the whole tale in that a considerable variation is found in average cutting size from mill to mill, although the nominal thickness of all mine guides for South Africa is the same.

Measurements were made on thickness of 355 mine lift guides on trucks at port of shipment, with results as shown on Table No. 32. It is thought that on this size the change in thickness on skids from time of cutting to time of loading would not be very pronounced.

TABLE 32.—SIZE VARIATION—MINE GUIDES NOMINAL THICKNESS, 4.25 INCHES.

Nominal Size. (Inches.)	Number of Pieces.					
	Mill No. 6.	Mill No. 7.	Mill No. 11.	Mill No. 4.	Mill No. 3.	Mill No. 8.
4·20	3	..	1	..	..	1
4·22	..	..	..	..	..	..
4·24	2	..	2	..	..	..
4·26	2	..	..	..	..	..
4·28	2	..	2	..	..	2
4·30	6	..	1	..	..	2
4·32	7	2	3	..	..	..
4·34	9	1	2	..	..	..
4·36	9	2	4	..	1	2
4·38	11	..	3	..	2	3
4·40	17	10	6	..	2	4
4·42	8	7	1	..	3	3
4·44	13	12	5	..	3	1
4·46	8	9	4	2	4	1
4·48	11	8	9	4	10	..
4·50	8	9	5	2	6	..
4·52	3	4	1	5	7	..
4·54	2	4	2	1	7	..
4·56	1	2	..	2	2	..
4·58	..	1	..	1	1	..
4·60	..	1	..	..	..	..
4·62	1	..	..	1	..	..
4·64	..	..	..	..	..	..
4·66	..	..	..	1	..	..
4·68	..	..	..	2	..	..
4·70	..	..	..	..	..	..
Total pieces ..	123	72	51	21	49	19
Mean	4·40	4·46	4·41	4·54	4·49	4·37
Variation—						
Under	·20	·14	·21	·08	·13	·17
Over	·22	·14	·13	·14	·21	·09
Total	·42	·28	·34	·22	·34	·26

In this connexion, a circular recently issued by the head office of a group of mills is of very great assistance. The following is an extract:—

> For some little time, attention has been given to a uniform allowance to be made when cutting out various orders. In the past, when an order has been split up over two or more mills, the allowance has sometimes varied at each mill, with the result that the buyer may receive timber measuring three different sizes. Complaints consequently arise.
>
> To obviate this, the following instructions should be strictly adhered to:—
>
> 1. *Scantlings* (unless otherwise specified).—For supplying local orders within the State, eastern States, and South Africa, up to 5 inches in width, allowance 1-16 inch. From 5 to 9 inches in width, allowance ⅛ inch. Sliding beams for South Africa, ¼ inch allowance in width and ⅛ inch in thickness.
>
> 2. *Wagon Scantlings.*—Up to 8 inches wide, allowance ¼ inch in width and ⅛ inch in thickness; over 8 inches and up to 12 inches wide, allowance ⅜ inch in width and ⅛ inch in thickness; over 12 inches wide, allowance ½ inch in width and ⅛ inch in thickness.
>
> 3. *Boards.*—In boards cut for stripping, 6 x 1 and 5 x 1, the allowances shall be 3-16 inch in width and 1-16 inch in thickness; for 4 x 1 the allowances shall be ⅛ inch in width and 1-16 inch in thickness.
>
> 4. *Parquetry Flooring.*—For 3 x 1, 3 x 1¼, 4 x 1, and 4 x 1¼, the allowances shall be 3-16 inch in width and 1-16 inch in thickness.

The sizes given are said to be minimum sizes.

On observations at the various mills the minimum sizes are a fraction below those given in the above circular.

As a result of our investigations, we would recommend the following instructions for general use:—

Unless otherwise specified, the allowance aimed at and maximum and minimum allowances above nominal size shall be as stated in Table No. 33.

For products not covered in this table, allowances can be made corresponding to a similar class of product for which figures are actually given.

In this report it is intended to stress more the form of the table than the actual figures given. Although based on a large number of observations, there is such a variation in practice from mill to mill that some small modifications may be desirable.

The main point is that some such table approved by one or more of the larger sawmilling companies would be an invaluable guide to their own mills and to other smaller millers who might be called upon to supply portion of the requirements for any order.

TABLE 33.—RECOMMENDED ALLOWANCES IN SIZE ABOVE ORDER SIZE (Unless other specified).

Class of Product.	Allowance aimed at—	Maximum Allowance.		Minimum Allowance.
		Lengths to 20 feet.	Lengths over 20 feet.	
Ordinary building and construction timber—all markets—				
Dimension—				
Up to 4"	1/8	1/4	5/16	0
5" to 8"	3/16	3/8	1/2	0
9" to 12"	1/4	1/2	5/8	0
Over 12"	3/8	3/4	1	0
Wagon scantling—				
Dimension—				
Up to 4"	1/8	1/4		1/16
5" to 8"	1/4	7/16		1/8
9" to 12"	3/8	5/8		3/16
Over 12"	1/2	7/8		1/4
For long lengths (e.g., 9 3/4" x 3 3/8" x 33') special allowances might be made.				
Boards—				
3" and 4"	1/8	1/4		1/16
5" and 6"	3/16	11/32		3/32
Thickness	3/32	5/32		1/32
Parquetry, 3" and 4"	3/16	5/16		1/8
Thickness	3/32	5/32		1/32
Mine Guides—				
8 1/4" x 4 1/4" up to 32' Width ..	1/4	1/2		1/8
Thickness	1/8	5/16		1/16
For other sizes make corresponding allowances.				
Crossarms—				
About 2 1/2" x 3 1/4"	3/16	5/16		1/8

The importance of a limit on the maximum size should be stressed. With a minimum size only specified in a mill with faulty equipment or a careless sawyer, the tendency is to raise the average size rather than to improve methods. The presence of oversize material mixed with well-cut material from the other mills gives a very bad appearance to the whole parcel. In any case, excessive oversize is a serious defect from the buyer's point of view in most classes of product.

IV.—COMPLETE LIST OF RECOMMENDED GRADING RULES.

Introduction.—The grading rules given in this section of the report are those considered to be in a suitable form for tentative adoption. They have been prepared after a detailed examination of comparatively small parcels, and tested out and modified where necessary on large consignments of material. Other rules, particularly for karri, have been developed in the main body of the report, but these are not shown in this section, as further work is necessary before they can be regarded as more than trial specifications.

While at first sight grading rules may appear complicated, a detailed examination in the field of consignments of timber will show that provisions are reasonably simple and can be readily interpreted after

a little practice. It should be remembered also, as stressed in the report, that the detailed rules define the border line only of a grade, and have only to be applied to a small percentage (usually about 20 per cent.) of the whole parcel.

This section of the report is intended to be generally complete in itself, except where reference is made to other sections. Considering, however, the tentative nature of recommended grading rules at this stage, these should be considered in conjunction with the whole body of the report.

The division of subject matter in the report does not lend itself to a similar numbering of specifications in this section. For convenience and ready reference, all specifications have been given a number corresponding to the section in the main report, followed by a letter according to the order in which the specification is listed. Thus all specifications numbered 1 followed by a letter refer to ordinary building and construction timbers; all numbered 2 refer to flooring, and so on. Each specification distinguished by a number and letter is qualified by any general provisions given under the number alone.

1. Ordinary Building and Construction Timber.

General Provisions.

1. Material as described in these rules must be graded taking into consideration its suitability for constructional purposes in the shape and size in which it is ordered and shipped. It is not intended to cover material suitable for re-sawing into smaller sizes.

2. The general features only of a grade can be covered by rules, and a total variation of 5 per cent. between the grading of individual inspectors is reasonable.

3. The enumerated defects described in any grade are intended to cover the lowest-quality pieces such grade may contain.

4. The allowance for wane shall be considered in conjunction with any oversize in the piece.

5. In all grades except for Select up to 99 square inches tight gum veins up to 10 inches x 1-16 inch shall be neglected in totalling gum for limiting clauses.

6. Rules are written to cover material green from the saw. Seasoning defects will be allowed at the discretion of the inspector unless otherwise specified.

7. In sizes 100 square inches and over, the limitation of defects as given shall be used as a guide only with due consideration given to the general quality of the piece and the location of defects.

8. For Select and Merchantable A grades, the total variation in sawing in lengths up to 20 feet shall not exceed $\frac{1}{4}$ inch for material up to 4 inches dimension, 5-16 inch for material 5 inches to 8 inches, 7-16 inch for material 9 inches to 12 inches, or 9-16 inch for material over 12 inches. In longer lengths, an increase of 25 per cent. in total variation will be allowed.

For Merchantable B grade, an increased allowance of 25 per cent. on the above provisions will be made.

1a. Jarrah Scantling (up to 25 square inches)—Select.

To be free from heart, brittle wood, included sap, rot, shakes, and serious cross grain, but allowing sap and any two of the following defects to the extent indicated:—

1. Wane not to exceed $\frac{1}{4}$ inch x $\frac{1}{4}$ inch, the length not to exceed 1 foot for 3 inches x 1 inch nor 3 feet for 6 inches x 4 inches.

2. Tight gum on any face up to one-eighth the length of the piece, individual lengths not to exceed 2 feet, with one small gum pocket up to 4 inches x $\frac{3}{8}$ inch measured on the quarter in any 5 lineal feet.

3. One sound, tight, intergrown knot up to 1 inch diameter in any 5 lineal feet.

4. Clean pinholes well scattered, not to exceed 10 in any half square foot.

5. Equivalent defect.

Provided that not more than 15 per cent. in volume shall be on the grade limit.

1b. Jarrah Scantling (up to 25 square inches)—Merchantable A.

This grade is not a mixed grade, and need contain no material above the Select limit, but not more than 10 per cent. shall be on the grade limit as defined below.

Timber to be suitable for sound construction purposes, free from heart, rot, and shakes, allowing sap and occasional grub holes and any one of the following defects to the extent indicated:—

1. Wane not to exceed one-sixth the dimension of the face on which it occurs, total length not to exceed one-sixth the length of the piece.

2. Gum pockets not to exceed one 5 inches x $\frac{3}{8}$ inch measured on the quarter on any face in any 5 lineal feet.

3. Tight gum veins on any face, with no pockets, total length not to exceed one-third the length of the piece and individual length not to exceed 4 feet.

4. If associated with limiting gum pockets, tight gum veins not to exceed one-sixth the length of the piece.

5. One sound, tight, intergrown knot up to $1\frac{1}{4}$ inch diameter, or other knot $\frac{3}{4}$ inch diameter, if not through, in any 5 lineal feet.

6. Clean pinholes not to exceed 15 in any half square foot.

In addition, a combination of smaller defects equivalent to one of the abo·e will be admitted, provided the combination of defects on all faces at any section will not materially impair the strength of the piece.

1c. Jarrah Scantling (up to 25 square inches)—Merchantable B.

This grade is not a mixed grade and need contain no material above the Select limit, but not more than 20 per cent. shall fall below the grade limit for Merchantable A.

Timber to be suitable for sound construction purposes, free from heart, rot, and shakes, allowing sap and occasional grub holes and any one of the following defects to the extent indicated:—

1. Wane not to exceed one-fourth the dimension of the face on which it occurs, total length not to exceed one-fourth the length of the piece.

2. Gum pockets not to exceed one 6 inches x ⅜ inch measured on the quarter on any face in any 5 lineal feet.

3. Tight gum veins on any face with no pockets, total length not to exceed half the length of the piece.

4. If associated with limiting gum pockets, tight gum not to exceed one-fourth the length of the piece.

5. One sound, tight, intergrown knot up to 1½ inch diameter, or other knot up to 1 inch diameter if not through, in any 5 lineal feet.

6. Soft included sap not to exceed 5 square inches in any 10 lineal feet. Sound included sap no defect.

7. Clean pinholes not to exceed twenty in any half square foot.

In addition, a combination of smaller defects equivalent to one of the above will be admitted, provided that the combination of defects on all faces at any section will not materially impair the strength of the piece.

1d. Jarrah Scantling (up to 25 square inches) Common.

Insufficient observations have been made to define this grade clearly, and the following must be treated as a suggestion only.

Timber to be suitable in the form as sold for cheaper construction purposes free from rot (unless allowed for temporary construction), but allowing any other defect that excludes from Merchantable B grade, provided that defects do not reduce the effective section at any point by more than one-third. End splits will be allowed up to 1 foot, but beyond that docking must be carried out.

1e. Jarrah Scantling (up to 25 square inches)—Merchantable A and Better.

This grade shall consist of not less than 40 per cent. by volume above the grade limit for Scantling Select, not more than 10 per cent. on the grade limit for Scantling Merchantable A, and the balance definitely above the grade limit for Merchantable A.

1f. Jarrah Scantling (up to 25 square inches)—Merchantable B and Better.

This grade shall consist of not less than 30 per cent. above the grade limit for Scantling Select, not more than 15 per cent. between the grade limits of Scantling Merchantable A and Scantling Merchantable B, and the balance above the grade limit of Merchantable A.

1g. Jarrah Heavy Scantling (26 to 99 square inches)—Select.

To be free from heart, brittle wood, included sap, rot, shakes, and serious cross grain, but allowing sap and any two of the following defects to the extent indicated:—

1. Wane not to exceed one-twelfth the dimension on which it occurs or $\frac{3}{4}$ inch.

2. Gum pockets not to exceed one 5 inches x $\frac{3}{8}$ inch measured on the quarter, in any 5 lineal feet.

3. Tight gum veins on any face with no pockets not to exceed one-sixth the length of the piece, individual length not to exceed 3 feet.

4. If associated with limiting gum pockets, tight gum not to exceed one-eighth the length of the piece.

5. One sound, tight, intergrown knot up to $1\frac{1}{4}$ inch diameter or other knot up to $\frac{3}{4}$ inch diameter, if not through, in any 5 lineal feet.

6. Scattered pinholes up to ten per half-square foot.

7. Equivalent defect.

Provided that not more than 20 per cent. in volume shall be on the grade limit.

1h. Jarrah Heavy Scantling (26 to 99 square inches)—Merchantable A.

Timber to be suitable for sound construction purposes, free from heart, rot, and shakes, but allowing sap and occasional grub holes and any one of the following defects to the extent indicated:—

1. Wane not to exceed one-sixth the dimension on which it occurs or $1\frac{1}{2}$ inch or one-sixth the length.

2. Gum pockets not to exceed one 6 inches x $\frac{3}{8}$ inch measured on the quarter in any 5 lineal feet.

3. Tight gum veins on any face with no pockets, total length not to exceed one-third the length, individual lengths not to exceed 4 feet.

4. If associated with limiting gum pockets, tight gum veins not to exceed one-sixth the length of the piece.

5. One sound, tight, intergrown knot up to $1\frac{1}{2}$ inch diameter or other knot up to 1 inch diameter, if not through, in any 5 lineal feet.

6. Clean pinholes not to exceed fifteen in any half-square foot.

In addition, a combination of smaller defects equivalent to one of the above will be admitted, provided the combination of defects on all faces at any section will not materially impair the strength of the piece.

Not more than 15 per cent. in volume of any parcel shall be on the grade limit.

1i. Jarrah Heavy Scantling (26 to 99 square inches)—Merchantable B.

Timber to be suitable for sound construction purposes, free from heart, rot, and shakes, but allowing sap and occasional grub holes and any one of the following to the extent indicated.

1. Wane not to exceed one-quarter the dimension on which it occurs or $1\frac{1}{2}$ inch or one-quarter the length.

2. Gum pockets not to exceed one 7 inches x $\frac{1}{2}$ inch measured on the quarter in any 5 lineal feet.

3. Tight gum veins on any face with no pockets, total length not to exceed half the length of the piece.

4. If associated with limiting gum pockets, tight gum veins not to exceed one-fourth the length of the piece.

5. One sound, tight, intergrown knot up to 2 inches diameter or other up to $1\frac{1}{2}$ inches diameter, if not through in any 5 lineal feet.

6. Pinholes not to exceed twenty in any half-square foot.

In addition, a combination of smaller defects equivalent to one of the above will be admitted, provided the combination of defects on all faces at any section will not materially impair the strength of the piece.

Not more than 25 per cent. in volume shall fall below the Merchantable A limit.

1j. Jarrah Heavy Scantling (100 square inches and over)—Select.

Timber to be free from heart, rot, and shakes, and serious cross grain, but allowing sap and any two of the following defects:—

1. Wane not to exceed one-twelfth the dimension on which it occurs.

2. Gum pockets not to exceed one 6 inches x $\frac{3}{8}$ inch, measured on the quarter in any 5 lineal feet.

3. Tight gum veins on any face with no pockets, total length not to exceed one-quarter the length of the piece.

4. If associated with limiting gum pockets, tight gum veins not to exceed one-sixth the length.

5. One sound, tight, intergrown knot up to 2 inches diameter or other knot up to $1\frac{1}{4}$ inches diameter, if not deep in any 5 lineal feet.

6. Scattered pinholes up to ten per half-square foot.

7. Equivalent defect.

Not more than 20 per cent. in volume shall be on the grade limit.

1k. Jarrah Heavy Scantling (100 square inches and over)—Merchantable A.

To be suitable for sound construction purposes, free from heart and rot, but allowing sap and any one of the following defects to the extent indicated:—

1. Wane *not to exceed one*-sixth the dimension on which it occurs, or 2 inches or one-sixth the length.
2. Gum pockets not to exceed one 7 inches x ½ inch measured on the quarter in any 5 lineal feet.
3. Tight gum veins on any face with *no pockets, total* length half the length of the piece, individual length not to exceed 6 feet.
4. If associated with limiting gum pockets, tight gum not to exceed one-quarter the length.
5. Tight intergrown knots or one other knot up to 1½ inch diameter, if not deep in any deep in any 5 lineal feet.
6. Pinholes not to exceed fifteen in any half-square foot.
7. Longitudinal shakes will be allowed at the discretion of the inspector, but if running to an end, the length shall not exceed the greatest cross sectional dimension of the piece, nor shall the shake run from one face to another on the end section.

In addition, a combination of smaller defects equivalent to one of the above will be allowed, provided that the combination of defects on all faces at any section will not materially impair the strength of the piece.

Not more than 15 per cent. in volume shall be on the grade limit.

1l. Jarrah Heavy Scantling (100 square inches and over)—Merchantable B.

To be suitable for sound construction purposes, free from heart and rot, but allowing sap and any one of the following defects to the extent indicated:—

1. Wane not to exceed one-sixth the dimension on which it occurs, or 2½ inches, or one-quarter the length of the piece.
2. Gum pockets not to exceed one 9 inches x ¾ inch measured on the quarter on any 5 lineal feet.
3. Tight gum veins on any face with no pockets, total length not to exceed three-quarters the length of the piece.
4. If associated with limiting pockets, tight gum veins not to exceed one-third the length.
5. Tight intergrown knots, or one other knot up to 2 inches diameter, if not deep in any 5 lineal feet.
6. Pinholes not to exceed twenty in any half-square foot.
7. Longitudinal shakes will be allowed at the discretion of the inspector, but if raising to an end, the length shall not exceed the greatest cross-sectional dimension of the piece, nor shall the shake run from one face to another on the end section.

In addition, a combination of smaller defects equivalent to one of the above will be allowed, provided that the combination of defects on all faces at any section will not materially impair the strength of the piece.

Not more than 25 per cent. in volume shall fall below the grade limit of Merchantable A.

1m. Jarrah Heart-in Beams—Merchantable B.

Sizes 12 x 12 and over may be heart-in, provided that the heart is well boxed and that other defects shall be considered on the basis defined for Heavy Scantling Merchantable A for 100 sq. ins. and over.*

1n. Karri Ordinary Building and Construction Timber.

Sufficient field work was not carried out to make definite recommendations *in the case of karri. Trial grade limits are, however,* given in the body of the report.

2. Flooring.

2a. Jarrah Strip Flooring Milled—Ballroom Grade.

General Provisions—

1. The general features of a grade can be covered by rules, and a total variation of 5 per cent. between the grading of individual inspectors is reasonable.

2. Where the term "nominal square foot" is used, the product of the nominal width and the length is intended for the rule.

3. Unless otherwise specified, nominal and milled sizes shall conform to the following table:—

Nominal size.		Milled size.
6 x 1	.. .. ..	$5\frac{1}{4}$ x $\frac{7}{8}$
5 x $1\frac{1}{4}$	.. .. ..	$4\frac{1}{4}$ x 1 3-32
5 x 1	.. .. ..	$4\frac{1}{4}$ x $\frac{7}{8}$
4 x 1	.. .. ..	$3\frac{3}{8}$ x $\frac{7}{8}$
3 x 1	.. .. ..	$2\frac{1}{2}$ x $\frac{7}{8}$

4. The maximum allowable moisture content should be specified by the buyer.†

5. The enumerated defects described in any grade are intended to cover *the lowest-quality* boards *such grade may contain, but* not more than 10 per cent. of the boards shall contain defects on the grade limit.

Grade Limit—

To be well machined from sound timber, the face and edges above the tongue and groove to be free from sap and all defects other than any two of the following:—

1. Tight gum veins not more than 1-16 inch wide, individual lengths not to exceed 3 inches, with a combined length not exceeding 1 inch for each nominal square foot or equivalent gum.
2. Two holes not greater than 1-16-in. diameter for each three nominal square feet, not more than three being grouped in any 6 square inches.
3. One hole not to exceed $\frac{1}{8}$-in. diameter for each 5 nominal square feet.
4. A straight end split not to exceed 4 inches on one end or its equivalent on both ends.
5. Equivalent defect.

---

* A special study of heart-in beams has not been carried out, but from the observations made, it is considered that the above specification would be suitable, provided a clause is added covering the condition of the heart, pipe, &c.

† Tentatively a maximum moisture content of 15 per cent. is recommended.

The rest of the edges and back may contain sap and defects which will not affect the perfect laying of the floor. Skip in the middle is no defect, but at the edges it shall not exceed 3 square inches for each inch nominal width in any one place, and shall not reduce the bearing surface by more than one-fifth at any section.

NOTE.—In the exceptional cases where perfect floors are called for, a Super Ballroom Grade can be specified. For this grade, boards shall be selected from the Ballroom Grade, selection being based on provision of a perfect face and a fair average even colour in the boards. This grade represents the best flooring it is possible to produce.

2b. Jarrah Strip Flooring, Milled—House Grade.

General Provisions.—

As for Ballroom Grade.

Grade Limit—

To be well machined from sound timber, allowing on the face and edges above the tongue and groove any one of the defects below, or combination of smaller defects equivalent to one defect:—

1. Two square inches of sap for each nominal square foot, but not wider than one-sixth the width of the board.
2. Tight gum veins not wider than 1-16 inch, individual lengths not to exceed 3 feet and combined length 1 foot for each nominal square foot; or tight gum veins not wider than $\frac{1}{8}$ inch, individual lengths not to exceed 1 foot, and combined length 4 inches for each nominal square foot or tight gum equivalent in effect in any other form.
3. One tight knot flecked with bark or gum up to a diameter in eighths of an inch equal to the width of the board, or one smooth, clean, tight knot up to twice this diameter in any board.
4. Two very small holes not greater than 1-16 inch diameter for each nominal square foot, not more than four being grouped in any four square inches.
5. One small hole not greater than $\frac{1}{4}$ inch diameter for each 3 square feet.
6. Splits with a barely perceptible opening if not more than 6 inches at one end or its equivalent at both ends.
7. Equivalent defect.

The rest of the edges and the back may contain sap and defects which will not affect the perfect laying or strength of the floor. Skip in the middle is no defect, but on the edge it shall not reduce the bearing area by more than one-quarter that of any section.

2c. Jarrah Strip Flooring, Milled—House Grade and Better.

This grade shall consist of not less than 30 per cent. above the Ballroom limit, together with not more than 10 per cent. on the House Grade limit, the balance to be definitely above the House Grade limit.

2d. Jarrah Strip Flooring, Milled—Reject Flooring.

Flooring under this heading will allow any defect which excludes the board from First Quality House Grade. Production of this flooring is not aimed at, the board receiving the same attention in cutting, seasoning, and milling as higher grades, but being thrown out of the high grade by some defect. By docking, at least 80 per cent. of the flooring should be suitable for uses where it will be covered, but no board showing more than 40 per cent. waste should be included or allowance made for any cutting less than 2 feet long.

2e. Jarrah Strip Flooring, Rough—Ballroom Grade.

General Provisions—

1. The general features only of a grade can be covered by rules, and a total variation of 5 per cent. between the grading of individual inspections is reasonable.

2. Where the term "nominal square foot" is used, the product of the nominal width and the length is intended for the rule.

3. Unless otherwise specified, boards shall be sawn of sufficient size to enable production after seasoning to the standard sizes suggested for milled flooring.*

4. In partly seasoned or seasoned boards, the maximum moisture-content should be specified by the buyer.†

TABLE 34. SUGGESTED CUTTING SIZES FOR FLOORING.

Nominal Size.		Green Size Aimed at.	Minimum Green Size.	Maximum Green Size.	Milled Size.
6 x 1	..	6 3/16 x 1 3/32	6 3/32 x 1 1/32	6 11/32 x 1 5/32	5 1/4 x 7/8
5 x 1 1/4	..	5 3/12 x 1 5/16	5 3/32 x 1 1/4	5 11/32 x 1 3/8	4 1/4 x 1 3/32
5 x 1	..	5 3/16 x 1 3/32	5 3/32 x 1 1/32	5 11/32 x 1 5/32	4 1/4 x 7/8
4 x 1	..	4 1/8 x 1 3/32	4 1/16 x 1 1/32	4 11/32 x 1 5/32	3 3/8 x 7/8
3 x 1	..	3 1/8 x 1 3/32	3 1/16 x 1 1/32	3 11/32 x 1 5/32	2 1/2 x 7/8

5. The enumerated defects described are intended to cover the lowest quality boards that the grade may contain, but not more than 10 per cent. of the pieces shall contain defects on the grade limit.

Grade Limit—

To be well sawn from sound timber, the face and adjacent half edges to be free from sap and all defects which will not mill out, except that as provided below.

Any two of the following will be allowed on the face:—

1. Tight gum veins not more than 1-16 inch wide, individual lengths not to exceed 3 inches, with a combined length not exceeding 1 inch for each nominal square foot or equivalent gum.

* The following table covers suggestions for sawing sizes allowing for seasoning and milling to the specified sizes.

† For boards described as air dried a maximum of 25 per cent. is suggested. For boards intended for immediate milling for the local market a maximum of 15 per cent. is suggested.

2. Two holes not greater than 1-16 inch diameter for each three nominal square feet, not more than three being grouped in any 6 square inches.

3. One hole not to exceed $\frac{1}{8}$ inch diameter for each 5 nominal square feet.

4. In seasoned or part-seasoned boards a straight end split not to exceed 4 inches on one end or its equivalent on both ends. (Ends splits not permitted on green boards.)

5. Equivalent defect.

The lower half of the edges and back may contain defects which will not prevent machining of a firm tongue and groove or affect the perfect laying or strength of the floor.

2f. Jarrah Strip Flooring, Rough.—House Grade.

General Provisions—

As for Ballroom Grade.

Grade Limit—

To be well sawn from sound timber, allowing on the face and adjacent half edges any defect which will mill out, and in addition any one of the following, or combination of smaller defects equivalent to one defect:—

1. Two square inches of sap for each nominal square foot, but not wider than one-sixth the width of the board.

2. Tight gum veins not wider than 1-16 inch, individual lengths not to exceed 3 feet, and combined length 1 foot, for each nominal square foot; or tight gum veins not wider than $\frac{1}{8}$ inch, individual lengths not to exceed 1 foot and combined length 4 inches for each nominal square foot or tight gum equivalent in effect in any other form.

3. One tight knot flecked with bark or gum up to a diameter in eighths of an inch equal to the width of the board; or one smooth, clean, tight knot up to twice this diameter in any board.

4. Two very small holes not greater than 1-16 inch diameter for each nominal square foot, not more than four being grouped in any 4 square inches.

5. One small hole not greater than $\frac{1}{4}$ inch diameter for each 3 square feet.

6. In seasoned or part-seasoned boards, a straight end split not to exceed 6 inches on one end or its equivalent on both ends. (End splits not permitted in green boards.)

The lower half of the edges and back may contain defects which will not prevent machining of a firm tongue and groove or affect the perfect laying or strength of the floor.

2g. Jarrah Strip Flooring, Rough.—House Grade and Better.

This grade shall consist of not less than 30 per cent. above the Ballroom limit, together with not more than 10 per cent. on the House Grade limit.

2h. Karri Flooring.

Grades for karri flooring have not yet been written, but it is thought that with slight modification the grading rules for jarrah would be suitable. The principal modification would be elimination of sap in untreated karri flooring.

2i. Jarrah Strips for Production of Wood Block Flooring. (One grade only.)

Size.—According to buyer's requirements.

Variation.—The following variations will be allowed on the green size from cutting instructions:

Upper limit, $\frac{1}{8}$ inch in width and 1-16 inch in thickness.

Lower limit, 1-16 inch in width and 1-16 inch in thickness.*

Cutting.—Unless otherwise specified, mixed back- and quarter-cut material will be supplied. Material shall be well sawn with square edges and ends.

Quality.—Not less than 70 per cent. shall be free from all defects. In the remaining 30 per cent., the better face and adjacent half edges shall be free from sap and all defects which will not machine out. On the back and lower half edges, sap and one of the following in any 2 lineal feet will be allowed:—

1. Tight gum veins not exceeding two-thirds the length of individual blocks.
2. One grub hole up to $\frac{1}{4}$ inch diameter.
3. One tight intergrown knot up to $\frac{1}{2}$ inch diameter.
4. Scattered pinholes but not more than four in any lineal foot.

Moisture content.—May be specified—

(*a*) Green from the saw—meaning 50-70 per cent.

(*b*) Air dried—meaning under 25 per cent.

Bundling.—Blocks shall be securely tied with material that does not cause discoloration of the wood. The better face of outside strips shall be turned into the bundle.

2j. Jarrah Wood Block Flooring—Milled.

Size and Design.—According to buyer's requirements.

Allowable Variation in Size.—Not yet determined.

Quality.—Not less than 70 per cent. shall be free from sap and all defects.

In the remaining 30 per cent., the better face and edges above the tongue and groove shall be free from sap and all defects, except that surface checks of total length less than 2 inches and of no appreciable width and slight torn grain which will be removed in sanding will each be allowed to the extent of 5 per cent. of the total number of blocks.

---

* On the present custom of the trade with 3 x 1 nominal size as an example, the average cutting size is about $3^3/_{16}$" x $1^3/_{32}$" with 95 per cent. at a mill with such an average falling within $3^1/_8$" to $3^5/_{16}$ by $1^1/_{32}$ to $1^5/_{32}$. An allowance in length of $^1/_4$" per block plus an additional half-inch is usually made to allow for docking blocks to individual lengths and squaring ends.

In addition, the rest of the edges and back will allow sap and slight skip up to one-quarter the area, and any one of the following defects:—

1. Tight gum veins not exceeding two-thirds the length of the blocks.
2. One grub hole up to $\frac{1}{4}$ inch diameter.
3. One sound tight knot up to $\frac{1}{2}$ inch diameter.
4. Four pin holes in any block.
5. Equivalent defect.

Moisture content.—The maximum allowable moisture content should be specified by the buyer.*

Bundling.—Bundles to be securely tied in an approved fashion, so that with reasonable care in handling negligible damage to blocks should take place in transit.

2k. Karri Wood Block Flooring—Rough and Milled.

No specifications have been written, but the same specification as for jarrah should apply, except that in untreated blocks no sap would be allowed.

3. Mine Lift Guides.

General Provisions—

1. Enumerated defects are intended to cover the lowest quality pieces the grade may contain, but not more than 15 per cent. shall be on the grade limit.

2. Specifications are written to cover material green from the saw. Seasoning defects will be allowed at the discretion of the inspector.

3. In guides where the thickness approaches the width, larger faults will be allowed towards the back edges at the discretion of the inspector.

4. Size according to buyer's requirements.†

5. Spring shall not exceed 1 inch in 25 feet or its equivalent.

3a. Jarrah Mine Lift Guides. (One grade only.)

To be from sound timber, free from heart, rot, unsound knots, and end shakes, but allowing the following defects to the extent indicated:—

On one face or either edge—

1. Tight gum veins, total length when gum veins under 10 inches x 1-16 inch long are neglected shall not exceed one-eighth the length of the piece.

   Gum veins near corners likely to shell off to be treated as equivalent to wane.

2. Gum pockets not to exceed one 4 inches x $\frac{3}{8}$ inch in any 5 lineal feet.

---

* Recommendations will be made for any particular case if required.

† Observations indicate that with $8^1/_4$ x $4^1/_4$ guides 25–32-ft. long, the custom of the trade is reasonably covered by the following:—Size aimed at, $8^1/_2$ x $4^3/_8$: maximum sizes—$8^3/_4$ and $4^9/_{16}$; minimum sizes $8^3/_8$ and $4^6/_{16}$.

3. One tight intergrown knot not to exceed 1½ inch diameter or its equivalent in any 5 lineal feet.

4. Wane not to exceed ½ inch on the face or ⅜ inch on the edge.

5. Equivalent defect.

On the other face—

Defects in excess of the above will be allowed, wane being limited to 1½ inch on the face and ¾ inch on the edge, or one-sixth the length of the pieces.

All provided that the combination of defects on all faces at any section will not seriously impair the utility of the piece for a mine guide.

3b. Karri Mine Lift Guides. (One grade only.)

To be from sound timber, free from heart, wane, unsound knots, rot, and end shakes, but allowing the following defects to the extent indicated:—

On one face or either edge—

1. Gum veins, total length when gum veins under 6 inches long are neglected shall not exceed one-tenth the length of the piece.

2. Gum pockets not to exceed one 4 inches x ⅜ inch in any 5 lineal feet.

3. One tight intergrown knot up to 1½ inch diameter or its equivalent in any 5 lineal feet.

4. Individual surface grub tracks limited to 16 inches x ⅜ inch and ¼ inch deep or equivalent.

5. Occasional grub holes up to ⅜ inch diameter if well scattered.

6. Equivalent defect.

On the other face—

Defects in excess of the above will be allowed.

All provided that the combination of defects on all faces at any section will not seriously impair the utility of the piece for a mine guide.

Where guides are fluarised, wane will be allowed to the same extent as in jarrah guides, i.e. to ½ inch x ⅜ inch on the better face, and 1½ inch x ¾ inch or up to one-sixth the length on the worst face.

4a. Karri Crossarms. (One grade only.)

General—

1. Defects enumerated are intended to cover the lowest quality arms that any parcel may contain, but not more than 15 per cent. shall contain defects on the grade limit.

2. The specification is written to cover material green from the saw. Seasoning defects will be allowed at the discretion of the inspector.

3. A total variation in grading of 5 per cent. between individual inspectors shall be considered reasonable.

Size.—According to buyer's requirements.

Variation.—The following variations will be allowed on the green size from cutting instructions:—Maximum size ⅛ inch above, and minimum size 1-16 inch below.

Cutting.—Crossarms shall be sawn with adjacent sides at right angles and ends shall be docked square to exact length.

Quality.—To be from sound timber, free from heart, shakes, rot, and serious cross grain.* but allowing defects to the extent indicated below:—

1. Tight gum veins not to exceed 6 inches in length or ⅛ inch in width on any face, and shall not show on the end of the arm.

2. Pinholes not to exceed ten on any face, with not more than four in any 6 square inches.

3. Grub holes not to exceed two ¼ inch diameter on any face, and shall not occur within the centre foot of the arm.

4. Sap on the corner up to ½ inch x ½ inch or equivalent to be considered in conjunction with any oversize.

5. Equivalent defect.

5a. Jarrah Paving Blocks. (One grade only.)

1. *Material.*—To be sound truewood, free from sap, heart, shakes, rot, and large gum veins, but allowing any one of the following to the extent indicated:—

(*a*) Tight gum veins, total visible length not to exceed 6 inches, provided they will not allow shelling.

(*b*) Occasional pinholes, total number of visible holes on all faces not to exceed four.

(*c*) Equivalent defect.

2. *Dimensions.*—Blocks to be clean sawn with sharp arrises to the following dimensions, unless otherwise specified:—

Length.—In multiples of 1 inch, not less than 5 inches or greater than 10 inches, the proportions to be as separately specified.

Depth.—Four and a half inches.

Width.—Three inches.

The blocks shall be cut so that the depth measurement shall be in the direction of the grain of the wood.

3. *Tolerances.*—The blocks shall conform to the dimensions specified within the following margins of tolerance:—

	+	−
Length	¼ inch	⅛ inch
Width	⅛ inch	1-16 inch
Depth	1-32 inch	1-32 inch

* It is realized that severity of cross grain should be defined by a maximum allowable slope, but insufficient data are available at the present time to suggest any clause other than "Arms to be free of serious cross grain".

LIST OF APPENDICES.

Appendix No. 1.—Existing Specifications—

(*a*) Grading rules for jarrah adopted by the Sawmillers' Association of Western Australia.

(*b*) Sawn jarrah logs and planks for South African railways and harbours.

(*c*) Australian hardwood for the Public Works Department, New Zealand.

(*d*) Sawn jarrah for the Victorian Railways.

(*e*) Sawn jarrah for the Commonwealth Railways.

(*f*) Sawn jarrah for the Melbourne and Metropolitan Tramways Board.

(*g*) Australian Postmaster-General's specification for cross-arms.

(*h*) Jarrah paving blocks for City of Melbourne.

Appendix No. 2.—Proposed Specifications (previous to this Report)—

(*a*) Proposed grading rules for Australian hardwoods, Western Australian Sub-committee of Standards Association, 1928.

(*b*) Proposed grading rules for milled jarrah flooring. Drafted 26th April, 1932.

(*c*) Proposed specification for strips for production of wood block flooring by an English flooring company.

(*d*) Proposed specification for hardwood paving blocks by Standards Association, 1931.

Appendix No. 3.—Occurrence of Defects in Milled Flooring.

Appendix No. 1.

Existing Specifications.

(a) Present Grading Rules for Jarrah.

The Sawmillers' Association of Western Australia adopted the following grading rules for jarrah timber in 1921:—

(a) "*Select*" to be straight-grained, well-sawn, free from sap or wane, knots, shakes, or heartwood.

But will allow up to 3 inches thick and 8 inches wide small gum streaks, small skrinkage shakes, and isolated pinholes; over that size, defects in all cases to be considered in connexion with the size and length of the piece and its general quality.

(b) "*Merchantable*" to be sound, strong timber, well sawn to size, free from heart timber and defects that naturally impair its strength.

But will allow slight variation in sawing, gum pockets not greater than 6 inches long by ⅝ inch wide; sound gum veins, few pinholes, but not in groups; wane up to quarter of the length of the piece but not to exceed 10 per cent. on either face; sun shakes; sizes 12 inches by 12 inches and over shall have heart in.

(b) Sawn Jarrah Logs and Planks for South African Railways and Harbours. Sawn Jarrah (Eucalyptus marginata, Sm.)—

The sawn jarrah timber is to be in all respects the best of its kind, sound, well-seasoned, and to be accurately sawn to the dimensions specified, *and will be subject to inspection and acceptance as conforming to this specification in regard to quality, on delivery at Union ports specified in the schedule attached.*

The jarrah timber must be straight-grained, free from ring shakes, large and dead knots, large gum veins, gum pockets, pipes, excessive wane, or other imperfections that will materially impair its strength and durability when resawn. All planks and smaller sections to be free from heartwood and cup shakes. Superficial gum veins will be allowed, but same must not in the aggregate exceed 20 per cent. of the length of the piece.

The sawn jarrah timber will be subject to inspection by the Government of Western Australia, which must be covered by the usual Government certificate that the jarrah timber has been inspected by an authorized officer of the Forests Department, Perth, Western Australia, and is true to the species mentioned; the contractor shall bear all the expenses of such inspection at the port of shipment.

All jarrah timber 9 inches x 6 inches or its equivalent, and over, to be—

(1) Thickly painted or thickly greased at the ends; and

(2) the ends to be suitably dogged to prevent the timber splitting.

(c) Australian Hardwood Timbers for the Public Works Department, New Zealand.

[Extract from General Specification P.W.S. 42.]

Timber supplied (excepting when otherwise specially specified) shall be—

1. For sawn or hewn timber—

   (3) Jarrah.

2. For sleepers . . .

3. For piles . . .

4. For poles . . .

5. All timber shall be first class of its kind, cut from mature trees to full dimensions specified, smoothly hewn or well sawn, die-square and out of winding, with sharp arrises, straight and sound, free of wane, pipe, or defective heart, shakes, ring-shakes, split ends, spalls, fractures, gum pockets or excessive gum veins, impairing grub or knot holes, trace of white ant, or other defects which might affect the utility of the timber.

6. All pieces of ironbark timber whose minimum dimension is 6 inches, or hardwood whose minimum dimension is 7 inches, excepting blackbutt, bluegums, turpentine, or Tasmanian stringybark, whose minimum dimension is 10 inches, shall be sawn and free of heart: other timber may be sawn or hewn, with sound tight heart in the centre.

7. All squared timber, piles, and poles shall be cut with sufficient addition to the length specified to allow of the ends being squared or trimmed. All sleepers . . .

8. All piles and poles . . .

9. All timber shall (before shipment) be inspected, passed, and branded by a Government Forestry officer of the State in which it is obtained.

(d) *Sawn Jarrah for the Victorian Railways.*

Specification.—Timber shall be carefully selected and shall be merchantable quality jarrah, sawn die square, and free from all sapwood, heartwood, shakes, large loose or dead knots, waney edges, and other defects, and shall hold throughout the dimension shown in the Schedule.

(e) *Sawn Jarrah for the Commonwealth Railways.*

Specification usually placed on orders.—The whole of the timber shall be of the best quality, free from sapwood, heartwood, shakes, large, loose or dead knots, waney edges, warp and defects of any sort. All timber shall be sawn die square and shall hold throughout to the dimensions shown.

(f) *Sawn Jarrah for Melbourne and Metropolitan Tramways Board.*

Specification for jarrah and certain other Australian hardwoods is as follows:—

The timber must be of good quality and of mature growth. When finished, the stringers shall be sound and free from heart and sapwood, large knots, grub-holes, splits, gum veins, sun cracks, warps, shakes, traces of white ant and defects of every description. Stringers shall be cut with grain as shown in the marginal sketch.

Ends shall be sawn square and the following variations from the above-stated dimensions will be permitted:—

Length	½ inch under to 1½ inch over.
Width	¼ inch under to ¼ inch over.
Depth	Nothing under to 1-16 inch over (when dressed).

Stringers must be dressed on one side by machine to give a smooth face and an even depth, not varying more than 1-16th inch throughout the contract. The dressing shall be done on the outer side of the wood (i.e. the side nearer the sap). All edges must be straight and parallel, and a variation from straightness exceeding ¼ inch in the total length may be considered as cause for rejection. Stringers with cracked ends will be rejected, and any pieces with cracked ends arriving in the Board's store will be docked, and only the accepted lengths after docking will be paid for. Short lengths will not be accepted. The cost of docking shall be deducted from any moneys held by the Board and due or becoming due to the "Contractor."

Each stringer must be branded by the inspector, and no stringer which has not been passed by the inspector or which does not bear his official brand will be accepted.

It has been ascertained that the stringers will be dressed in Melbourne, so that the stringers will be inspected as sawn timber, allowance being made for dressing. In all other respects, the timber must meet the requirements as specified.

Inspectors should see that the stringers are cut the correct way of the grain, as shown in the sketch. It is reported that a fair number were, on a previous occasion, passed, although cut on the quarter. This is a serious defect and should not be allowed.

(g) *Specification for Crossarms—Wooden.*

Commonwealth of Australia. Postmaster-General's Department.

(Specification No. 533B. (Replacing Specification No. 533A.) Issued 18th May, 1932.)

The finished products required under this specification are wooden crossarms of the pattern and dimensions specified on the drawing referred to in the invitation to tender.

2. *Timbers*—

2.1. The crossarms shall be of approved species of timber as named in the invitation to tender, and shall be of sound timber unaffected by termites (white ants), grubs, borers, fungus, or other injurious condition, and, except that blemishes will be permitted within the limits specified hereunder, shall be entirely free from large or loose knots, splits or shakes, long or wide gum veins or other defects which would reduce the strength or appreciably alter the shape of the crossarms.

2.2. *Gum Veins.*—Tight small gum veins (under 1-16 inch in width) will be permitted, provided—

(*a*) No gum vein exceeds 18 inches in length.
(*b*) Combined lengths do not exceed 36 inches on any face.
(*c*) Gum veins do not emerge through edges or ends of arm.

2.3. *Knots.*—Not more than two sound tight small (not over ½ inch in diameter) knots permissible, provided that no knot shall be within 6 inches of centre bolt hole, or within 2 inches of any spindle hole or between any spindle hole and the side of the arm, or within 10 inches of any other knot. Alternatively, knots smaller than ½-in. diameter shall be allowed in numbers considered by the inspecting officer to be not more than the equivalent in defect of two ½-in. knots, provided that the maximum number of knots so allowed shall not exceed six.

2.4. *Grain.*—The crossarms shall be generally straight grained, with the grain approximately in the same direction as the length of the arm. The maximum inclination of the grain to any one face shall not exceed a slope of 1 in 30 or an angle of approximately 2°.

2.5. *Checks.*—Small surface checks will be permitted, provided they do not exceed 4 inches in length and are of no appreciable depth. Internal checks shall be not more than ½ inch long as measured on the end surface, and not more than one shall appear on each end of the arm. No through checks will be permitted.

2.6. *Shakes and Splits.*—The crossarms shall be entirely free of shakes and splits.

2.7. The timber shall be wholly solid truewood; no sapwood, bark, or heart shall be present in any crossarm.

3. *Cutting and Finish*—

3.1. Crossarms shall be sawn with their adjacent sides at right angles, and shall be free from splinters or split edges. The ends of the crossarms shall be sawn at right angles to the sides, and shall be free from splits.

3.2. In timber subject to collapse or shrinkage, the crossarm shall be cut so that the growth rings extend from one face to the parallel face in such a manner that the angle of inclination of the growth rings to such parallel faces shall be not less than 70°.

4. *Spindle and Bolt Holes*—

4.1. Where spindle and/or bolt holes are required as prescribed in the invitation to tender, they shall be bored in the crossarms at points as shown on the drawing and of the diameter specified in the invitation to tender. All spindle and bolt holes shall be bored clean and with sharp edges, to the precise diameter required, and at right angles to the faces bored.

5. *Tenderers shall state*—

(*a*) Species (i.e. botanical name) and local name of timber to be supplied.

(*b*) District from which timber will be cut.

(*c*) Month of year in which the crossarms will be cut.

(*d*) Approximate moisture-content to which timber will be seasoned at time of delivery.

6. The drawing referred to in the invitation to tender accompanies and forms *part of this specification.*

A glossary of terms is included in the specification.

(*h*) *Specification Covering Supply of Jarrah for Paving Blocks—City of Melbourne.*

[Extract.]

1. *Contract*—

This contract is for the supply and delivery to the undermentioned depot of . . . superficial feet of redgum or jarrah timber to be cut into blocks for wood-paving purposes. Delivery may be made either in the form of blocks or in planks; if the latter, the timber will then be cut into blocks as set out in Clauses 3 and 4.

2. *Description of Timber*—

The timber must be the soundest and densest description of approved redgum or jarrah, free from sappy fibre, knots, or other defects. All blocks containing heart gum veins shall be rejected. Blocks containing transverse gum veins shall be at the discretion of the Acting City Engineer or his representative.

3. *Size of Blocks*—

Respecting the suitability of the timber supplied under the contract, the decision of the Acting City Engineer shall be binding on the contractor, and it is to be understood clearly that the provision excluding sapwood will be enforced. The timber is to be cut by the contractor into blocks; each block to be true and square in exact lengths of 4½ inches long in the grain, to have a thickness of not less than 3 inches, and to be in varying widths, 9 inches, 8 inches, 7 inches, 6 inches, and 5 inches, the proportion of the first three widths to be not less than 55 per cent. A maximum allowance of 1-16 inch will be allowed in the 3-in. thickness of the blocks, so that when laid close in the work the blocks will show not only a smooth and even surface, but the arrises must be cut so clean that only a line joint will be visible between the blocks.

4. *Cutting at Yard*—

The contractor will be permitted to cut the timber into blocks at the yard, and for that purpose may place therein saw benches and saws on such conditions as may be arranged with the Council. The blocks must be delivered at the depot free of all charges for dues, freights, &c. There will be competent men to examine and take delivery of the blocks. Should the contractor not elect to cut the blocks in the yard, the blocks are to be stacked properly and neatly by the contractor, care being taken to separate the different sizes so that they may conveniently be gauged and counted. If the blocks be cut at the yard, the sizes will be gauged from the saw, and the contractor must shift the gauged blocks from the bench and stack as directed by the storeman. Only those blocks which pass the Council's gauge will be paid for, and rejects must be removed from the yard when so required by the Acting City Engineer.

Appendix No. 2.

Proposed Specifications (previous to this Report).

(a) Proposed Grading Rules for Australian Hardwoods.

(Prepared by Western Australian Sub-committee of Standards Association on Building Materials in 1928.)

General—

In considering the grades of this specification, "specially select" timber shall be such as is suitable for the highest grades of work, for example, that with a polished finish; "select" timber shall meet the requirements of ordinary joinery purposes, where the finish is by painting or varnishing; "merchantable" timber shall be for general carpentry and structural work where hidden.

In the case of "dry boards," "specially select" shall refer to flooring of a standard suitable for ballroom floors, or similar purposes, while the lining and other timber of this grade shall be fit for polishing. "Select" dry boards shall be suitable for ordinary domestic purposes where, for example, floors are covered and linings are oiled, painted, or varnished.

Grades—

1. "Specially select" to be straight-grained and well sawn, as follows:—
   (*a*) Planks or boards—One side and two edges, to be free from all defects, which would render the timber unfit for polishing.
   (*b*) Squares—Four sides to be free from *all* defects, which would render the timber unfit for polishing, and where specially specified free from winding.

2. "Select" to be straight-grained, well sawn, free from sap or wane, knots, shakes, heartrot, and where specially specified free from winding. But will allow in sizes up to 3 inches thick and 8 inches wide small sound gum veins, small shrinkage shakes, and (in Western Australian hardwoods only) isolated pin-holes; over that size defects in all cases to be considered in connexion with the size and length of the piece and its general quality.

3. "Merchantable" to be sound, strong timber, well sawn to size and free from heartrot and defects that naturally impair its strength. But will allow slight variation in sawing; gum pockets not greater than 6 inches long by ⅜ inch wide; sound gum veins; (in Western Australian hardwoods only) few pinholes but not in large groups; wane up to quarter of the length of piece, but not to exceed 10 per cent. on either face; sun shakes, sizes over 3 inches thick and 8 inches wide will allow larger gum pockets and small loose gum veins according to size of pieces sizes 10 inches by 10 inches and over or of 100 square inch cross-section and over may have heart in.

Dry Boards (Flooring, Lining, &c.)—

4. "Specially select" to be sound, well sawn, free from sapwood and all defects, on one face and two edges.

5. "Select" to be sound, well sawn, free from gum pockets or wane; but will allow sound gum veins.

Moisture-content of Timber—

The percentage moisture-content of dry boards, &c., may, if desired, be specified, and when required the standard test for moisture-content shall be as follows:—

Representative pieces shall be selected on the basis of three samples for parcels up to 50 cubic feet, one sample per 100 cubic feet for parcels up to 1,000 cubic feet, with a minimum of ten samples. From each sample pieces shall be cut at a distance of not less than 2 feet from an end, a thin section, and this shall be immediately weighed, thoroughly dried, and reweighed. The moisture-content shall be expressed as a percentage of the oven-dry weight as follows:—

$$\text{Moisture-content per cent.} = \frac{\text{original weight—oven-dry weight} \times 100}{\text{oven-dry weight.}}$$

The average moisture-content of the samples shall not exceed at all, and no sample shall exceed by more than 1 per cent., the moisture-contents specified.

The moisture-content section shall not be over 1 inch nor less than ⅝ inch in length along the grain, and shall be dried from 48 to 72 hours in an oven maintained at a temperature between 212° F. and 220° F.

(*b*) *Proposed Grading Rules for Milled Jarrah Flooring, Drafted 26th April, 1932.*

(Based on deliberations of Western Australian Sawmillers' Committee.)

Ballroom Grade.—To be well machined from sound truewood, the face to be free from sap and all defects. The edges and back may contain defects which will not affect the perfect laying or strength of the floor.

Exceptionally light-coloured boards shall be excluded from the grade.

Any two of the following shall not be considered a defect, but blemishes approaching these shall not occur in more than 20 per cent. of the boards:—

On the Face—

1. Tight gum veins not more than 1-16 inch wide, individual lengths not to exceed 3 inches with a combined length not exceeding 1 inch for each nominal square foot or equivalent gum.
2. Two holes not greater than 1-16-in. diameter for each three nominal square feet, not more than three being grouped in any 6 square inches.
3. Slight machine burn.
4. A straight end split not to exceed 4 inches in one end or its equivalent in both ends.

On the back—

5. Skip at the edges shall not exceed 2 square inches for each inch nominal width in any one place, and shall not reduce the bearing surface by more than one-sixteenth at any section.

NOTE.—In the exceptional cases, where perfect floors are called for, a super-ballroom grade can be specified. For this grade, boards shall be selected from the ballroom grade, selection being based on provision of a perfect face and fair average even colour in the boards. This grade represents the best flooring it is possible to produce.

First-quality House Grade.—To be well machined from sound timber, allowing on the face any one of the defects below, or combination of smaller defects equivalent to one defect. The edges and the back may contain defects which will not affect the perfect laying or strength of the floor.

Defects Allowed on the Face—

1. Two square inches of sap for each nominal square foot, but not wider than one-sixteenth the width of the board.
2. Tight gum veins not wider than 1-16 inch, individual lengths not to exceed 3 feet and combined length 1 foot for each nominal square foot; or tight gum veins not wider than ⅛ inch individual lengths not to exceed 1 foot and combined length 4 inches for each nominal square foot or tight gum equivalent in effect in any other form.
3. One tight knot flecked with bark or gum up to a diameter in eighths of an inch equal to the width of the board, or one smooth, clean, tight knot up to twice this diameter in any board.
4. Two very small holes not greater than 1-16-in. diameter for each nominal square foot, not more than four being grouped in any four square inches.
5. One small hole not greater than ¼-in. diameter for each three square feet.
6. Small surface checks over a quarter of the area.
7. Splits with a barely perceptible opening if not more than 6 inches at one end or its equivalent at both ends.
8. Any defect not enumerated equivalent to any of the above defects.

Skip on the back at the edges shall not exceed 3 square inches for each inch nominal width in any one place, and shall not reduce the bearing surface by more than one-fifth at any section.

The specification defines the limiting board in the grade, but any parcel shall contain a fair average of boards up to the bottom limit of the ballroom grade, and not more than 20 per cent. shall contain defects approaching those allowed in the limiting board.

Reject Flooring.—Flooring under this heading will allow any defect which excludes the board from first-quality house grade. Production of this flooring is not aimed at, the board receiving the same attention in cutting, seasoning, and milling as higher grades, but being thrown out of the higher grade by some defect. By docking at least 80 per cent. of the flooring should be suitable for uses where it will be covered, but no board showing more than 40 per cent. waste should be included or allowance made for any cutting less than 2 feet long.

(c) Proposed Specification for Strips for the Production of Jarrah Flooring Blocks Finishing 9 x 3 x ⅞.

Size.—The minimum length shall be 19 inches; other lengths shall be 19 inches plus multiples of 9¼ inches (but charged as 18 inches and up, rising in 9-in. multiples).

Cutting Variation Allowed.

Maximum section	3½ x 1¼
Minimum section	3.3-16 x 1.1-32
Minimum length	As above.

Cutting.—Unless otherwise specified, mixed back and quarter cut material may be supplied at shipper's option, but not less than 50 per cent. of the pieces shall be cut on the quarter. Material shall be well sawn with square edges and ends squared.

Quality.—The better side of a strip shall be known as the top side and the other side as the underside. The top face and edges within half an inch of the top face shall be free of sap and all defects. On the lower ½ inch of the edges and the underside, the following may be allowed:—

1. Sap, but not more than 5 per cent. of the strips shall contain sap.
2. Small tight gum veins, but not more than 10 per cent. of the pieces shall contain gum veins.
3. Pinholes not exceeding 1-16 inch in diameter, and not more than two in any lineal foot, and in not more than 5 per cent. of the pieces.

All pieces containing defects under the above classification (1), (2), (3) to be shipped on a separate bill of lading.

Bundling.—Strips to be securely bundled and tied with such a material as will not cause discoloration of the strips. The top face of the top and bottom pieces to be turned into the bundle. Each bundle to contain the same number of pieces of the same length.

Moisture-content.—Air-dried, which means under 25 per cent.

(d) Proposed Australian Standard Specification for Hardwood Paving Blocks (Standards Association, 1931).

1. *Material.*—Hardwood paving blocks shall be of the best-quality hardwood, free from deadheart, sapwood, shakes, gum veins, knots, or any other imperfections, and shall be cut from sound well-grown trees.

2. *Dimensions.*—The blocks shall be clean sawn to the following dimensions:—

Length.—Not exceeding 10 inches nor less than 6 inches, the proportions to be as separately specified.

Depth.—Four and a half inches, unless otherwise specified.

Width.—Three inches.

The blocks shall be cut so that the depth measurement shall be in the direction of the grain of the wood.

3. *Tolerances.*—The blocks shall conform to the dimensions specified, within the following margins of tolerance:—

	+ Inch.	— Inch.
Length	¼ ..	¼
Width	¼ ..	1-16
Depth	1-16 ..	1-16

4. *Delivery.*—The blocks shall be gauged to 1-16 inch and delivered separately according to size. They shall, as far as possible, be delivered and stacked separately as regards the various classes of timber.

Appendix No. 3.

Occurrence of Defects in Milled Flooring.

In Table 34, 1,000 pieces, produced by a mill as "first class" flooring for present market conditions are *arranged in* qualities, and the quantitative occurrence of the various defects is shown.

Table 34.—An Analysis of Defects Occurring in "First Class" Flooring Produced for Present Trade Conditions.

			No. of pieces including defect.
Ballroom Grade—			
Clear			496
Very small defects—			
Holes		34	
Pinholes		23	
Gum spots		21	
Gum veins		8	
Blemishes		28	
Combinations		1	
Surface checks		6	
End splits		25	
Machining defects—			
Rough machining	18		
Slight skip	2		
Machine burn	12		
	—	32	178
Defects approaching Ballroom limit—			
Pinholes		22	
Gum veins		38	
Knots		2	
Blemishes		4	
Combinations		4	
End splits		26	
Machining defects—			
Rough machining	9		
Machine burn	1		
Deficient tongue	2		
	—	12	108
House Grade—			
Defects below, but close to, Ballroom limits			105
Defects definitely in House Grade			52
Defects approaching House Grade limits—			
Sap		17	
Pinholes		3	
Grub holes		1	
Gum veins		2	
Split		1	
Machining defect (skip)		6	
		—	30
Rejects—			
Sap		2	
Machine skip		2	
		—	4
Docking—			
To raise to Ballroom Grade			26
To raise to House Grade			1
			1,000

Table 35 is based on an examination of a fewer number of pieces produced as "second class" flooring for present trade conditions.

Table 35.—An Analysis of Defects Occurring in "Second Class" Flooring Produced for Present Trade Conditions.

		No. of pieces including defect.
Ballroom Grade—		
Blemishes		10
Defects approaching Ballroom Grade limits—		
Sap	1	
Gum veins	1	
Gum spots	5	
Pinholes	1	
Combinations	4	
Surface checks	4	
End splits	4	
Machining	3	
	—	23
House Grade—		
Defects below, but close to, Ballroom limits—		
Holes	2	
Pinholes	1	
Gum	2	
Knots	1	
Sap	1	
Combinations	14	
Surface checks	3	
End splits	2	
Machining	10	
	—	36
Defects definitely in House Grade—		
Sap	6	
Gum	32	
Pinholes	2	
Grub holes	7	
Knots	1	
Miscellaneous	4	
Combinations	27	
Surface checks	4	
Machining	6	
	—	89
Defects approaching limit for House Grade—		
Sap	3	
Gum	22	
Pinholes	4	
Grub holes	3	
Knots	2	
Miscellaneous	5	
Combinations	22	
Surface checks	2	
Machining	4	
	—	67
Rejects—		
Gum	19	
Pinholes	3	
Knots	1	
Miscellaneous	7	
Combinations	16	
Surface checks	2	
Machining	3	
	—	51

Besides the 276 pieces referred to in the above table for "second class" flooring, there were 65 pieces in the parcel examined which needed docking. These pieces for docking were classified according to the number of cuts, the amount of docking or the per cent. of face remaining, and the resulting grade. The results have not been shown in Table 35 as this is intended to show the defects and their significance in boards as now produced.

The data in Tables 34 and 35 may not represent average conditions for the classes of flooring produced by the trade in general. They refer to particular parcels of flooring, and are included to show the detail in which observations were made, and to give some perspective of the importance of the various types of defects. A very much greater quantity of flooring would need to be examined in similar detail, and the amount of sorting to which it had been subjected would have to be known before tables could be prepared to represent normal practice.

H. J. Green,
Govt. Printer, Melbourne.